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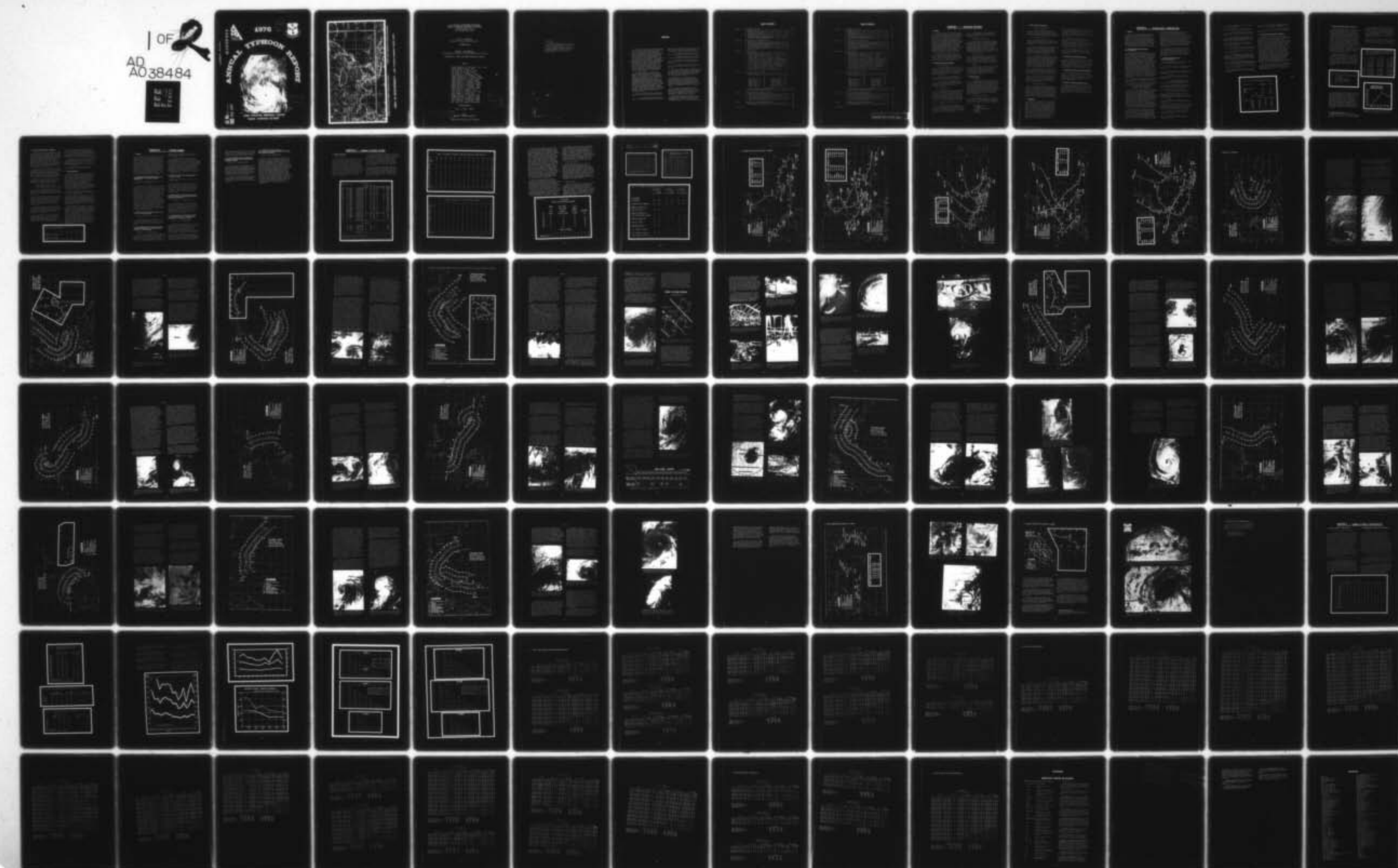
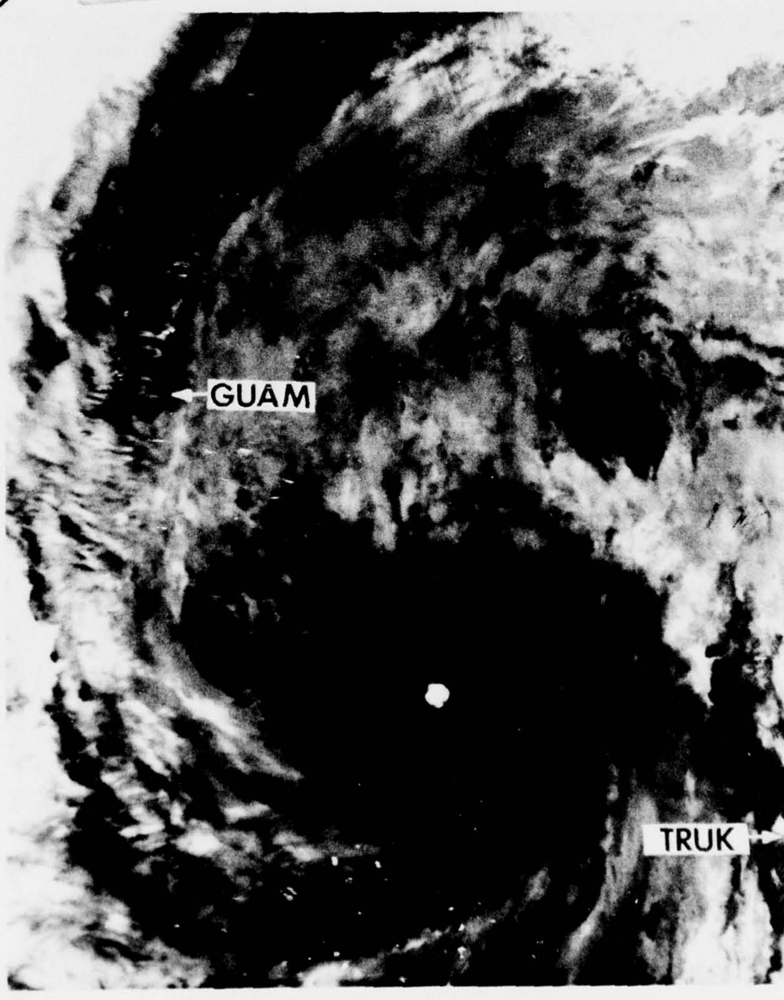
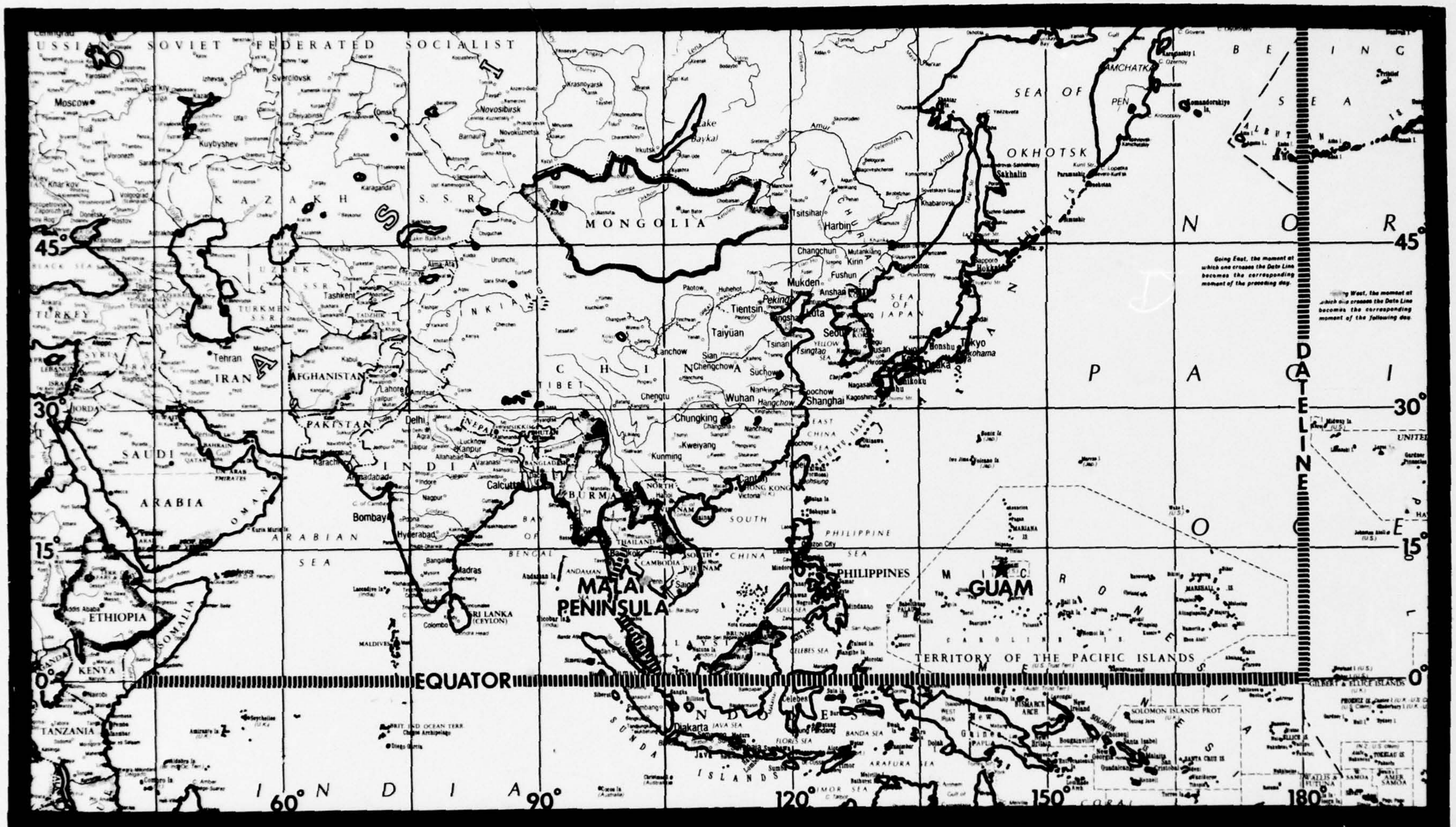


1976

ANNUAL TYPHOON REPORT



JOINT TYPHOON WARNING CENTER
GUAM, MARIANA ISLANDS



Indian Ocean Area (Malay Peninsula to Africa)

Pacific Area (Dateline to Malay Peninsula)

AREA OF RESPONSIBILITY - JOINT TYPHOON WARNING CENTER, GUAM

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1976
ANNUAL TYPHOON REPORT

*Departed during 1976 season

FRONT COVER:

Infrared photograph of Super Typhoon Pamela near peak intensity 275 nm southeast of Guam, 19 May 1976, 0901Z. Pamela subsequently passed directly over Guam inflicting massive damage to military and civilian facilities. Details of this destructive storm begin on page 24. (DMSP imagery)

FOREWORD

For centuries tropical cyclones have been a menace to both military and civilian activities in tropical and subtropical oceanic regions. During recent times much effort has been funneled toward more accurate tropical cyclone forecasts, and toward more efficient operational responses to these storms. A large portion of this effort has been based on studies which, if meaningful, must be based on accurately documented data. The Annual Typhoon Report represents such documentation. The body of this report summarizes the tropical cyclones occurring during 1976 in the western North Pacific, the Central North Pacific and the North Indian Oceans. The United States National Weather Service publishes summaries of eastern North Pacific tropical cyclones in the *Mariners Weather Log*, and Pilot Charts.

The PACOM Tropical Cyclone Warning System (western North Pacific and Indian Oceans) insures warnings of these dangerous storms is provided to all U. S. government interests. It consists of the Fleet Weather Central/Joint Typhoon Warning Center (FLEWEACEN/JTWC), the U. S. Air Force 54th Weather Reconnaissance Squadron stationed at Andersen AFB, Guam, and the U. S. Air Force Weather Service Defense Meteorological Satellite Program (DMSP) sites at Nimitz Hill, Guam; Clark AB, Philippines; Kadena AB, Okinawa; Osan AB, Korea; Hickam AFB, Hawaii; and the Air Force Global Weather Central, Offutt AFB, Nebraska. Additionally, satellite support is provided by the Fleet Weather Facility, Suitland, Maryland.

The Fleet Weather Central/Joint Typhoon Warning Center, Guam has the responsibility to:

1. Provide continuous meteorological watch of all tropical activity north of the Equator, west of the Date Line, and east of the African coast (JTWC area of responsibility) for potential tropical cyclone development;

2. Provide warnings for all tropical cyclones within the area of responsibility;

3. Determine tropical cyclone reconnaissance requirements and assign priorities;

4. Conduct post-analysis studies including preparation of the Annual Typhoon Report; and

5. Conduct tropical cyclone research and forecast improvement studies as time permits.

JTWC is an integral part of FLEWEACEN Guam and is manned by officers and enlisted personnel from both the Air Force and Navy. The senior Air Force officer is designated as the Director, JTWC, and the senior Naval officer as the Deputy Director, JTWC.

Detachment 17, 30th Weather Squadron, Yokota AB, Japan with assistance from the Naval Weather Facility, Yokosuka, Japan and computer support from Fleet Weather Central, Pearl Harbor, Hawaii is designated as the Alternate Joint Typhoon Warning Center in the event that FLEWEACEN/JTWC, Guam is incapacitated.

The Central Pacific Hurricane Center, Honolulu, Hawaii, is responsible for the area north of the equator from the Date Line east to 140W. Warnings are issued in coordination with FLEWEACEN, Pearl Harbor and Detachment 4, 1WW, Hickam AFB, Hawaii.

CINCPACFLT, CDRUSACSG, and CINCPACAF are responsible for further dissemination, and if necessary, local modification of tropical cyclone warnings to U. S. government interests.

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CHAPTER I - OPERATIONAL PROCEDURES

1. GENERAL

Services provided by the Joint Typhoon Warning Center (JTWC) include the following: (1) Significant Tropical Weather Advisories issued daily describing all tropical disturbances and their potential for further development; (2) Tropical Cyclone Formation Alerts issued whenever interpretation of satellite and synoptic data indicates likely formation of a tropical cyclone; (3) Tropical Cyclone Warnings issued four times daily whenever a significant tropical cyclone exists in the Pacific area; (4) Tropical Cyclone Warnings issued twice daily whenever a significant tropical cyclone exists in the Indian Ocean area; and (5) Prognostic Reasoning issued twice daily for tropical storms and typhoons in the Pacific area.

FLEWEACEN Guam provides computerized meteorological/oceanographic products for JTWC. Communication support is furnished by the Nimitz Hill Naval Telecommunications Center (NTCC) of the Naval Communications Area Master Station Western Pacific.

2. ANALYSES AND DATA SOURCES

a. COMPUTER PRODUCTS:

Varian plotted charts are routinely produced at synoptic times for the surface, 850 mb, 700 mb, and 500 mb. A chart of upper tropospheric data is produced which utilizes 200 mb rawinsonde data and AIREPS above 29,000 ft within 6 hours of the 0000Z and 1200Z synoptic times.

JTWC utilizes the FLEWEACEN Guam Computer Center for objective forecast techniques and statistical post-analysis.

In addition, the standard array of synoptic-scale computer analyses and prognostic charts are available from the Fleet Numerical Weather Central (FNWC) at Monterey, California.

b. JTWC ANALYSES:

(1) Combined surface/gradient level (3,000 ft) streamline analysis over tropical regions and an isobaric analysis in more northern latitudes and around intense tropical systems at 0000Z and 1200Z. The blend between streamlines and isobars fluctuates as the pressure gradient changes from season to season. Low-level wind directions from satellite data are included in the analysis.

(2) 500 mb contour analysis at 0000Z and 1200Z.

(3) Composite upper-tropospheric streamline analysis, utilizing rawinsonde data from 300 mb through 100 mb, wind directions extracted from satellite data by Det 1, 1WW and AIREPS (plus or minus 6 hours) at or above 29,000 feet, at 0000Z and 1200Z.

(4) Additional sectional analyses similar to those above, at intermediate synoptic times, during periods of tropical cyclone activity.

c. AIRCRAFT RECONNAISSANCE:

These data are invaluable in the positioning of centers of developing systems and essential for the accurate determination of the maximum intensity, minimum sea-level pressure, and radius of significant winds exhibited by tropical cyclones. Aircraft reconnaissance data are plotted on large-scale sectional charts for each mission flown. A comprehensive discussion of aircraft reconnaissance is presented in Chapter II.

d. SATELLITE DATA:

The Defense Meteorological Satellite Program (DMSP) played a major role in the early detection of tropical cyclones in 1976. A discussion of this role, as well as applications of satellite data to tropical cyclone tracking, is presented in Chapter II.

e. RADAR:

During 1976, land radar coverage was utilized more extensively in the Selective Reconnaissance Program than ever before. Once a storm moved within the range of a land radar site, reports were usually received hourly. Use of radar during 1976 is discussed in Chapter II.

3. FORECAST AIDS

a. CLIMATOLOGY:

Climatological publications utilized during the 1976 typhoon season include previous JTWC Annual Typhoon Reports and climatic publications from Fleet Weather Central Guam, Director Naval Oceanography and Meteorology, Naval Weather Research Facility, Naval Environmental Prediction Research Facility, Naval Postgraduate School, Air Weather Service, First Weather Wing and Chanute Air Training Center, plus publications from other Air Force and Navy activities, various universities and foreign countries.

b. OBJECTIVE TECHNIQUES:

The following objective techniques were employed in tropical cyclone forecasting during 1976. A description and an evaluation of these techniques is presented in Chapter V:

(1) TYFN75
(2) MOHATT 700/500
(3) FCSTINT
(4) 12-HR EXTRAPOLATION
(5) HPAC
(6) XT24
(7) INJAH74

4. FORECASTING PROCEDURES

a. INITIAL POSITIONING:

An initial center position is determined from a subjective evaluation of center fix data and synoptic data. When these data sources are not available, extrapolation from the previous position is used.

b. TRACK FORECASTING:

An initial forecast track is developed based on persistence, climatology and objective techniques. This initial track is subjectively modified based on the following:

(1) The prospects for recurvature are evaluated for all westward and northward moving storms. This evaluation is based primarily on present and forecast position and amplitude of middle tropospheric mid-latitude troughs from the latest 500 mb analysis and numerical prognoses.

(2) Determination of steering level is partly influenced by maturity and vertical extent of the system. For mature storms located south of the 500 mb subtropical ridge, forecast changes in speed of movement are closely correlated with forecast changes in the intensity of the ridge. When steering currents are very weak, the tendency for storms to move northward due to internal forces is an important consideration.

(3) Over the 12- to 72-hr forecast spectrum, speed of movement during the early time frame is biased toward persistence, while that near the end of the time frame is biased towards analogs and climatology.

(4) A final check is made against climatology to ascertain the likelihood of the forecast track. If the forecast deviates greatly from climatology, the forecast rationale is reappraised and the track adjusted as necessary.

c. INTENSITY FORECASTING:

In forecasting intensity, heavy reliance is placed on aircraft reconnaissance reports, the Dvorak satellite interpretation model, and the objective techniques discussed above. Additional considerations are the position and intensity of the tropical upper-tropospheric trough, extent and intensity of upper-level outflow, sea surface temperature, terrain influences, speed of movement, and proximity to an extratropical environment.

5. WARNINGS

Tropical cyclone warnings are numbered sequentially. If warnings are discontinued and the storm reintensifies, warnings are numbered consecutively from the last warning issued. Amended or corrected warnings are given the same number as the warnings they modify plus a sequential alphabetical designator. Each warning includes the location, intensity, direction and speed of movement, and the radial extent of 30, 50, and 100 kt surface winds (when applicable). Warnings within the JTWC Pacific Area are issued within 2 hours of 0000Z, 0600Z, 1200Z and 1800Z with the constraint that the 2 consecutive warnings may not be more than seven hours apart. This variable warning time allows for maximum use of all available reconnaissance platforms and spreads the workload in multiple storm situations. The forecast intervals for all tropical cyclones, regardless of intensity, are 12-, 24-, 48-, and 72-hr.

Warnings in the JTWC Indian Ocean area are issued within 2 hours of 0800Z and 2000Z with the constraint that 2 consecutive warnings may not be more than fourteen hours apart. Warnings for this area are issued only after a tropical cyclone has attained an intensity of greater than 33 kt. Forecast intervals are 24 and 48 hours.

Warning forecast positions are verified against the corresponding post analysis "best track" positions. A summary of the verification results for 1976 is presented in Chapter V.

6. PROGNOSTIC REASONING MESSAGE

In the Pacific Area, prognostic reasoning messages are transmitted at 0000Z, 1200Z or whenever the previous reasoning is no longer valid. This message is intended to provide field meteorologists with the reasoning behind the latest JTWC forecast. Prognostic reasoning messages are not prepared for tropical depressions nor for the Indian Ocean area.

7. SIGNIFICANT TROPICAL WEATHER ADVISORY

This message, summarizing significant weather in the entire JTWC area of responsibility, is issued by 0600Z daily. It contains a detailed, non-technical description of all significant tropical disturbances, and the JTWC evaluation of potential for tropical cyclone development.

8. TROPICAL CYCLONE FORMATION ALERT

Alerts are issued whenever interpretation of satellite and other meteorological data indicates significant tropical cyclone formation is likely. These alerts will specify a valid period not to exceed 24 hours and must either be cancelled, reissued or superseded by a warning prior to expiration of the valid period.

CHAPTER II – RECONNAISSANCE & COMMUNICATIONS

1. GENERAL

The Joint Typhoon Warning Center relies primarily on two reconnaissance platforms, aircraft and satellites, to provide the required fix data for tropical cyclone warnings. In 1976 these two platforms provided 74.7% of the fixes used for tropical cyclone warnings in the western North Pacific. Radar, synoptic data and extrapolation were the basis for the remaining 25.3%. In the Indian Ocean area of responsibility 89% of all warnings were based on satellite data.

2. RECONNAISSANCE RESPONSIBILITY AND SCHEDULING

Aircraft weather reconnaissance is performed in the JTWC area of responsibility by the 54th Weather Reconnaissance Squadron (54 WRS). The squadron, presently equipped with six WC-130 aircraft, is located at Andersen Air Force Base, Guam. From July through October, augmentation by the 53rd Weather Reconnaissance Squadron at Keesler Air Force Base, Mississippi brings the total number of available aircraft to nine. The JTWC reconnaissance requirements are provided daily throughout the year to the Tropical Cyclone Aircraft Reconnaissance Coordinator (TCARC). These requirements include area(s) to be investigated, tropical cyclone(s) to be fixed, fix times, and forecast position of fix. In accordance with CINCPACINST 3140.1M, "Usage of reconnaissance assets in acquiring meteorological data from aircraft, satellites and land-based radar shall be at the discretion of FLEWEACEN/JTWC Guam based on the following priorities:

(1) Alert flights and vortex or center fixes as required for issuance of tropical cyclone warnings in the Pacific area of responsibility;

(2) Center or vortex fixes as required for issuance of tropical cyclone warnings in the Indian Ocean area of responsibility;

(3) Supplementary fixes; and

(4) Synoptic data acquisition".

As in previous years, aircraft reconnaissance provided direct measurements of height, temperature, flight level winds, sea level pressure, estimated surface winds (when observable) and numerous additional parameters. These data provide the Typhoon Duty Officer indications of changing cyclone characteristics, radius of cyclone associated winds and position and intensity determinations. Another important aspect of this data is its availability for research in tropical cyclone analysis and forecasting. Aircraft reconnaissance will become even more important in years to come when high-resolution tropical cyclone dynamic steering programs will require a dense input of wind and temperature data.

DMSP satellites and USAF ground sites provide day and night coverage of the JTWC area of responsiblility. Interpretation of this satellite imagery provides cyclone positions, and for daytime passes estimates of storm intensities are also made. This year timely readouts were available at JTWC only for the 0000Z and 1200Z warnings. DMSP satellite positions received at JTWC from the Air Force Global Weather Central, Offutt Air Force Base, Nebraska were timely for the 0800Z and 2000Z warnings in the Indian Ocean. As in 1974 and 1975, satellite metwatch of the western North Pacific proved extremely useful in identifying areas of possible tropical cyclone formation, thus reducing the number of aircraft investigative flights. The Detachment 1, 1st Weather Wing DMSP site on Guam was modified in February 1977 to receive and process data from NOAA satellites.

Land radar also provides very useful positioning data on well developed cyclones when in proximity (usually within 175 nm of the radar site) of the Republic of the Philippines, the Republic of China, Hong Kong, Japan (including the Ryukyu Islands), Korea, and Guam.

3. AIRCRAFT RECONNAISSANCE EVALUATION CRITERIA

The following criteria are used to evaluate reconnaissance support to JTWC.

a. Six-hour fixes - To be counted as made on time, a fix must satisfy the following criteria:

(1) Fix must be made not earlier than 1 hr before, nor later than 1/2 hr after scheduled fix time.

(2) Aircraft in area requested by scheduled fix time, but unable to locate center due to:

(a) Cyclone dissipation; or
(b) Rapid acceleration of the cyclone away from the forecast position.

(3) If penetration not possible due to geographic or other flight restrictions, aircraft radar fixes are acceptable.

b. Levied 6-hr fixes made outside the above limits are evaluated as follows:

(1) Early-fix is made within the interval from 3 hr to 1 hr prior to scheduled fix times. However, no credit will be given for early fixes made within 3 hr of the previous fix.

(2) Late-fix is made within the interval from 1/2 hr to 3 hr after scheduled fix time.

c. When 3 hr fixes are levied, they must satisfy the same time criteria discussed above in order to be classified as made on time. Three-hour fixes made that do not meet the above criteria are classified as follows:

(1) Early-fix is made within the interval from 1 1/2 hr to 1 hr prior to scheduled fix time.

(2) Late-fix is made within the interval from 1/2 hr to 1 1/2 hr after scheduled fix time.

d. Fixes not meeting the above criteria are scored as missed.

e. Levied fix time on an "as soon as possible" (ASAP) fix is considered to be:

(1) Sixteen hours plus estimated time enroute after an alert aircraft and crew are levied; or

(2) Four hours plus estimated time enroute after the DTG message levying as ASAP fix if an aircraft and crew, previously alerted, are available for duty.

f. Investigatives - to be counted as made on time, investigatives must satisfy the following criteria:

(1) The aircraft must be within 250 nm of the specified point by the scheduled time.

(2) The specified flight level and track must be flown.

(3) Reconnaissance observations are required every half-hour in accordance with AWSM 105-1. Turn and mid-point winds shall be reported on each full observation within 250 nm of the levied point.

(4) Observations are required in all quadrants unless a concentrated investigation in one or more quadrants has been specified.

(5) Aircraft must contact JTWC before leaving area of concern.

g. Investigatives not meeting the time criteria of paragraph f, will be classified as follows:

(1) Late-aircraft is within 250 nm of the specified point after the scheduled time, but prior to the scheduled time plus 2 hr.

(2) Missed-aircraft fails to be within 250 nm of the specified point by the scheduled time plus 2 hr.

4. AIRCRAFT RECONNAISSANCE SUMMARY

During the 1976 tropical cyclone season 310 six-hourly vortex fixes and 7 supplementary vortex fixes were levied (Table 2-1). This was 100 more levied fixes than during 1975. Although there were 25 tropical cyclones in the Pacific area of responsibility during both 1975 and 1976, those of 1976 were generally longer lived and required 126 more warnings. This primarily accounts for the increase in levied fixes. Heavy reliance on DMSP data has continued to keep the number of aircraft levies low. For example, during 1970 470 aircraft fixes were levied for 533 warnings, whereas during 1976 only 310 fixes were levied for 635 warnings. In addition to vortex fixes 34 investigative missions were levied during 1976 compared with 21 during 1975. This increase resulted primarily from reduced timeliness, areal coverage and resolution of the DMSP satellite data. Approximately 45% of all warnings were based on aircraft fixes, 30% on satellite data, and the remaining 25% on radar, synoptic data and extrapolated positions.

Reconnaissance effectiveness is summarized in Table 2-1. The missed fix rate of 3.5% is slightly higher than the 3.2% of 1975, but remains significantly better than that from 1971 through 1974.

TABLE 2-1. AIRCRAFT RECONNAISSANCE EFFECTIVENESS

EFFECTIVENESS	NUMBER OF FIXES	PERCENT
COMPLETED ON TIME	284	89.6
EARLY	2	.6
LATE	20	6.3
MISSED	11	3.5
TOTAL	317	100.0

LEVIED VS. MISSED FIXES

	LEVIED	MISSED	PERCENT
AVERAGE 1965-1970	507	10	2.0
1971	802	61	7.6
1972	624	126	20.2
1973	227	13	5.7
1974	358	30	8.4
1975	217	7	3.2
1976	317	11	3.5

5. SATELLITE RECONNAISSANCE SUMMARY

Satellite reconnaissance of tropical cyclones is provided by the Air Force Weather Service Defense Meteorological Satellite Program (DMSP) network. This network uses data from polar orbiting DMSP spacecraft. Coverage of JTWC's area of responsibility is accomplished in the western North Pacific by direct-readout tactical sites at: Clark AB, Philippines; Kadena AB, Japan; Yokota AB, Japan[1]; Nimitz Hill, Guam; and Hickam AFB, Hawaii. Air Force Global Weather Central (AFGWC) at Offutt AFB, Nebraska, using stored data readouts from the spacecraft, monitors the North Indian Ocean, Bay of Bengal, and Arabian Sea, in addition to backing up tactical site operations when necessary. Operational control and tasking of the DMSP network by Detachment 1, 1st Weather Wing on Guam insures that positions and intensity estimates are supplied to JTWC as tropical cyclones spawn and develop.

DMSP derived positions of tropical cyclones are categorized into six classes according to the method of gridding and type of circulation center. These classes are identified by a Position Code Number (PCN) as shown in Table 2-2. Estimates of tropical cyclone intensity are obtained using the Dvorak technique (NOAA Technical Memorandum NESS 45 and subsequent refinements).

TABLE 2-2. POSITION CODE NUMBERS

PCN	METHOD OF CENTER DETERMINATION/GRIDDING
1	EYE/GEOGRAPHY
2	EYE/EPHEMERIS
3	WELL DEFINED CC/GEOGRAPHY
4	WELL DEFINED CC/EPHEMERIS
5	POORLY DEFINED CC/GEOGRAPHY
6	POORLY DEFINED CC/EPHERMERIS

CC=Circulation Center

A comparison of DMSP positions with the JTWC Best Track is shown in Table 2-3. A significant increase in satellite position error was observed in 1976. The mean deviation of 30.5 nm was an increase of 21% over the 1975 mean. This increase was attributable to the lack of Very High Resolution (VHR) visual data. Without VHR data it is frequently not possible to identify small islands and atolls necessary for precise gridding in oceanic regions. Geographic gridding was available for only 56% of this year's fixes, as opposed to 84% in 1975.

In 1976 the number of warnings in the western North Pacific that were based on DMSP data dropped to 30%, compared with 38% in 1975 (Fig. 2-1). This decrease was due to the non-availability of sufficient and timely DMSP spacecraft. Of the warnings that were issued twice daily for the North Indian Ocean, 89% were based on satellite positions.

Use of the "dual-site" tasking concept, which requires at least two DMSP sites to make each tropical cyclone fix, resulted in 99% of the tasked fixes being accomplished.

TABLE 2-3. Mean Deviations (nm) of DMSP Derived Tropical Cyclone Positions from JTWC Best Track Positions, 1974-1976 (all sites). Number of cases shown in parentheses.

PCN	1974 (ALL SITES)	1975 (ALL SITES)	1976 (ALL SITES)
1	13.6 (224)	11.8 (214)	12.4 (131)
2	17.4 (37)	20.4 (35)	20.1 (124)
3	20.1 (422)	21.2 (271)	21.7 (161)
4	23.9 (70)	22.4 (50)	29.3 (152)
5	35.4 (342)	34.2 (323)	40.4 (247)
6	49.4 (108)	44.7 (71)	49.0 (153)
1&2	14.2 (261)	13.0 (249)	16.1 (255)
3&4	20.6 (492)	21.4 (321)	25.4 (313)
5&6	38.8 (450)	36.1 (394)	43.7 (400)
TOTAL	26.0 (1203) (35 storms)	25.2 (964) (25 storms)	30.5 (968) (26 storms)

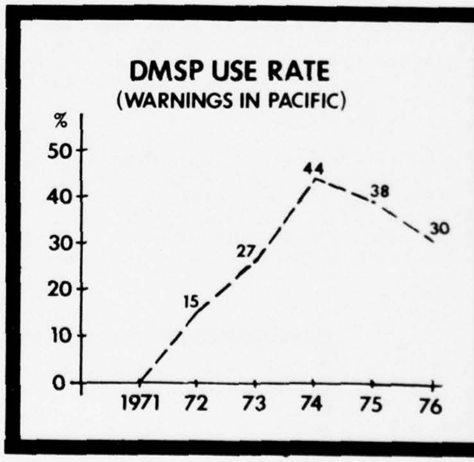


FIGURE 2-1. *Percentage of western North Pacific warnings based on DMSP fixes.*

1. Yokota AB site ceased operation in December 1976. A new site at Osan AB, Korea will be providing inputs to the DMSP network in 1977.

6. RADAR RECONNAISSANCE SUMMARY

During the 1976 typhoon season 862 radar center fixes were received at JTWC; 859 from land stations and 3 from aircraft. A WC-130 of the 54th Weather Reconnaissance Squadron (54th WRS) fixed Typhoon Marie by radar after earlier reconnaissance had experienced severe turbulence within the eye wall. A Pan American Boeing 747 flying from Manila to Guam fixed Typhoon Louise 385 nm north of Koror at 1035Z on November 2nd. Super Typhoon Pamela was fixed 100 nm east-southeast of Truk lagoon by a Continental Air Micronesia flight enroute to Guam from Truk.

The number of radar center fixes received at JTWC during 1976 is nearly twice the 444 received during 1975. However, the 12 storms that were under radar surveillance during 1976 were less than the 14 surveyed during 1975. This paradox resulted from the fact that in 1976 tropical cyclones moved slowly through regions of dense radar coverage.

Radar reports originating from national meteorological agencies are placed into 3 categories of accuracy. These categories as defined in the WMO radar code are:

1. good [within 10 km (5.4 nm)]
2. fair [within 10-30 km (5.4-16.2 nm)]
3. poor [within 30-50 km (16.2-27.0 nm)].

Of the 707 radar report encoded in this manner, 32% were classified good, 43% fair and 25% poor. Radar reports made while storms were of typhoon intensity had 35% in the good category.

All radar reports were compared to the JTWC best track. The mean vector deviation computed for land radar was 11.6 nm. The 3 aircraft radar fixes deviated an average of 16.0 nm from the best track. During 1975 the mean deviation for land and aircraft radar center fixes were 10.1 and 16.1 nm, respectively.

Of the 862 radar center fixes received, 71% were from sites of the various national meteorological agencies, 16% were from U. S. Air Force Air Weather Service sites and 13% were received from aircraft control and warning (AC & W) sites.

Of the 12 tropical cyclones that were fixed by land radar, nine, Ruby, Therese, Wilda, Anita, Billie, Dot, Fran, Louise and Marge had tracks within range of the highly reliable and extensive network maintained by the Japan Meteorological Agency (JMA). Five storms Ruby, Therese, Anita, Billie, and Fran were fixed simultaneously by 4 or more radar sites. Super Typhoon Fran was fixed by 10 different sites accounting for 215 fixes or 25% of the 1976 total. This represents the greatest number of fixes ever received at JTWC for a single tropical cyclone.

Geographically, sites in the Japan-Ryukyu network accounted for 83% of the 862 reports. The Philippines provided 7%, Taiwan and Hong Kong 4% each, and Guam 2%. No radar reports were received from the Indian Ocean area of responsibility.

During 1976 5% of the 689 warnings issued by JTWC were based on radar.

7. COMMUNICATIONS

JTWC receives its data and disseminates its warnings through a variety of communication systems, including AUTOVON, AUTODIN, the Naval Environmental Data Network (NEDN), and the Air Force's Automated Weather Network (AWN). Much of the basic meteorological intelligence is received via the NEDN and graphically displayed by FWC computers. More timely observations, tailored bulletins, and reports are received by JTWC on a dedicated AWN circuit directly from the AWN switch at Clark AB. AUTODIN is used for dissemination of warnings which are concurrently transmitted on the AWN.

A unique JTWC communication procedure, that between the reconnaissance aircraft and JTWC, is discussed below:

Aircraft reconnaissance data are normally received by JTWC via direct phone patch through the Andersen Aeronautical Station, which is the primary station for this purpose. Under degraded radio propagation conditions, the Clark or Yokota Aeronautical Stations can intercept and relay the data via AUTOVON and teletype to JTWC.

The preliminary eye/center data message contains sufficient information to permit JTWC to begin early preparation of individual warnings. During 1976 average communication delays for the preliminary and the complete eye/center data messages were 15 and 30 minutes, respectively. This represents a significant improvement over that of the past four years, where they had stabilized near 20 and 48 minutes, respectively. Delay times are defined as the difference between the fix time and the time of message receipt at JTWC. Table 2-4 depicts the complete eye/center data messages received more than 1 hour after fix time and after warning time.

TABLE 2-4. 1976 AIR/GROUND DELAY STATISTICS FOR AIRCRAFT RECONNAISSANCE

	1972	1973	1974	1975	1976
%Complete fix messages delayed over one hour	6	20	19	20	21
%Complete fix messages received after warning time	5.5	10.1	4.9	3.7	4.7

CHAPTER III - RESEARCH SUMMARY

1. GENERAL

One of the five major tasks of the Joint Typhoon Warning Center is to conduct limited tropical cyclone post-analysis and forecasting research, time and resources permitting. In most cases research projects are directly concerned with improvement of intensity forecasts or speed of movement and positioning forecasts of tropical cyclones. Meteorologists from outside agencies such as the Naval Environmental Prediction Research Facility, the Naval Postgraduate School, the 54th Weather Reconnaissance Squadron and Detachment 1, 1st Weather Wing often collaborate with JTWC on research projects. The following abstracts summarize research completed or underway during the past year.

2. CROSS-EQUATORIAL INTERACTIONS IN THE DEVELOPMENT OF A WINTER TYPHOON: NANCY 1970

(Guard, C. P., NAVENVPREDRSCHFAC TECH PAPER No. 4-76, UHMET 74-6)

Although winter typhoons can be as intense and destructive as seasonal ones, little research has been devoted to these "off-season tropical cyclones." This synoptic and dynamic study is of such a storm, Typhoon Nancy (19-27 Feb 70). It examines anomalies in the February 1970 circulation patterns over the Western Pacific and utilizes them to explain the formation and development of Nancy. Special emphasis is placed on the impact of cross-equatorial interactions during the storm's genesis. The study indicates that the rarity of "off-season tropical cyclones" may result, in part, from the absence of two conditions north of the equator during winter: low-level westerly winds and a sea surface temperature maximum. Evidence is also presented to suggest that the wall cloud and subsequent eye formation is contingent upon a rapid increase of upper level divergence above the developing system.

3. TROPICAL CYCLONE CENTER FIX DATA FOR THE 1975 TYPHOON SEASON

(Staff, FLEWEACEN/JTWC TECH NOTE 76-5)

A computer printout of all center fix data is displayed for each tropical cyclone occurring in the western North Pacific, the Arabian Sea and the Bay of Bengal during 1975.

4. AN EVALUATION OF UTILIZING EQUIVALENT POTENTIAL TEMPERATURE AS A MEASURE OF TROPICAL CYCLONE INTENSITY

(Milwer, F. P., FLEWEACEN/JTWC)

A post season evaluation of the credibility of the 700 mb equivalent potential temperature technique to forecast rapid or explosive deepening of tropical cyclones is currently in progress at JTWC. The technique utilizes values of θe which exceed or equal 370°K (365°K may be used if environment is favorable) to forecast rapid deepening within 12 to 24 hours (Sikora, 1976).

Preliminary results indicate that of the six storms that fell into the rapid or explosive deepening category during 1976, only two cases were found to correlate with a θe between 365°K and 370°K prior to rapid deepening. In general, the high θe values correspond to storms which were in the process of rapid or explosive deepening or had already peaked in intensity. The sample size was found to be too small to accurately determine the credibility of the technique, and an analysis of additional data is necessary to complete the evaluation.

5. RADIUS OF WIND FIELD SURROUNDING A TROPICAL CYCLONE

(Sokol, D., Metzger, G. P., Hern, R.L., FLEWEACEN/JTWC)

A preliminary analysis was conducted to determine the 100 kt, 50 kt and 30 kt wind radii surrounding a tropical cyclone, for use in cases when no detailed wind data are available. The 50th percentile was determined from a random sample based on JTWC warnings for super typhoons, typhoons and tropical storms.

6. CORRELATION OF JTWC INITIAL POSITION ERROR TO FORECAST POSITION ERRORS IN THE WESTERN NORTH PACIFIC

(Pilipowskyj, S., FLEWEACEN/JTWC)

A study correlating the JTWC initial warning position errors to 24-hour forecast errors shows a small but significant correlation. A regression analysis implies that 24-hour JTWC forecasts would improve to about a 90 nm vector error if the initial position error is reduced below 5 nm. Correlations for 48-hour and 72-hour forecasts are being calculated.

7. THE INFLUENCES OF THE TROPICAL UPPER TROPOSPHERIC TROUGH (TUTT) ON ERRATIC MOVEMENT OF TROPICAL CYCLONES

(Guard, C. P., FLEWEACEN/JTWC)

Although erratic movement has long presented a problem to the tropical cyclone forecaster, little light has been shed on the causes of this enigma. Frequently this movement has been attributed to "weak steering flow at mid-tropospheric levels". However, adequate explanations for this "weak steering flow" are lacking in the literature.

This study concentrates on the upper troposphere (200-mb level) where rawinsonde data is significantly augmented with aircraft reports. Results indicate a strong correlation between erratic movement of tropical

cyclones and movements of the TUTT. In many cases the TUTT is responsible for the entire erratic path of a tropical system; in others it merely initiates the abnormal movement.

8. THE DEVELOPMENT AND MOVEMENT OF TROPICAL CYCLONES IN DEEP SOUTHWESTERLY MONSOON SURGES

(Guard, C. P., FLEWEACEN/JTWC)

During August 1974 and September 1976 the western North Pacific was subjected to a stronger than normal southwesterly monsoon flow. This period was characterized by large pressure falls in the region of the near equatorial trough, strong southwesterly wind accelerations and deep southwesterly flow penetrating above the 500-mb level.

This study utilizes both satellite and synoptic data to illustrate the influences of this synoptic regime on the development, structure and movement of associated tropical cyclones.

9. OPERATIONAL APPLICATIONS OF A RECURVATURE - NON-RECURVATURE STUDY BASED ON 200-MB WIND FIELDS

(Guard, C. P., FLEWEACEN/JTWC)

One of the most difficult problems involving tropical cyclone forecasting is that of recurvature - non-recurvature. Colorado State University Atmospheric Science Paper No. 241, Tropical Cyclone Motion and Surrounding Parameter Relationships (John E. George, 1975) presented a recurvature - non-recurvature scheme based on 200-mb data composited from peripheral data surrounding 21 recurving and 21 non-recurving western Pacific typhoons. This 200-mb scheme was evaluated by JTWC based on 1974, 1975 and 1976 western North Pacific tropical cyclone data. Results indicated that even though the composited study required several alterations to be operationally practical, it provided a useful starting point. As a result, a follow-on recurvature - non-recurvature study was established, based on whether or not the Tropical Upper Tropospheric Trough (TUTT) is a persistent feature of the upper level synoptic pattern. Further evaluation is in progress.

CHAPTER IV — SUMMARY OF TROPICAL CYCLONES

1. GENERAL RESUME

a. WESTERN PACIFIC

In 1976 the number of tropical cyclones remained below the long term average. There were 25 numbered tropical cyclones in the JTWC area of responsibility, all of which progressed to tropical storm or typhoon intensity (Table 4-1). Although the number of tropical cyclones was the same as last year's total, the occurrence of named storms during 1976 increased by 25% (Table 4-2). Of the 25 storms, 14 attained typhoon intensity, including four super typhoons. The month of March was the only month without a numbered cyclone, while three months (February, March & December) were without a typhoon (Tables 4-2 and 4-3).

Table 4-4 indicates the number of tropical cyclone formation alerts issued by year. During 1976 there were 34 alerts, of which 25 developed to tropical storm or typhoon intensity. All storms of 1976 were preceded by a formation alert. The average lead time between the issuance of a formation alert and the first warning was 17.8 hours, with a minimum of 3.5 hours for Louise and a maximum of 64 hours for Marge.

The storm season had an early debut with typhoon Kathy forming in January. The near equatorial trough was firmly established by April and maintained itself throughout most of the remainder of the year. An exception was late September and most of October, when the westerly flow along the equator gave way to easterly trades.

TABLE 4-1.
1976 TROPICAL CYCLONES

PACIFIC AREA

CYCLONE	TYPE	NAME	PRD OF WRNG	CALENDAR DAYS OF WARNING	MAX SFC WIND	MIN OBS SLP	NO. OF WARNINGS TOTAL	NO. OF WARNINGS AS TY	DISTANCE TRAVELED
01	TY	KATHY	28 JAN-02 FEB	6	80	969	22	9	1966
02	TS	LORNA	27 FEB-01 MAR	4	35	---	13	--	806
03	TY	MARIE	03 APR-14 APR	12	115	929	44	32	955
04	TS	NANCY	25 APR-02 MAY	8	55	984	27	--	1279
05	TY	OLGA	12 MAY-27 MAY	16	100	934	60	8	2443
06	STY	PAMELA	14 MAY-27 MAY	14	130	921	52	40	2570
07	TY	RUBY	23 JUN-04 JUL	12	120	934	45	24	2798
08	TY	SALLY	24 JUN-03 JUL	10	115	923	37	23	2981
09	STY	THERESE	11 JUL-20 JUL	10	135	903	37	29	2290
10	TS	VIOLET	21 JUL-25 JUL	5	55	---	20	--	650
11	TS	WILDA	22 JUL-24 JUL	3	45	992	9	--	898
12	TY	ANITA	23 JUL-25 JUL	3	65	979	9	2	864
13	TY	BILLIE	03 AUG-10 AUG	8	125	914	31	17	1854
14	TS	CLARA	05 AUG-07 AUG	3	40	---	7	--	263
15	TS	DOT	18 AUG-23 AUG	6	50	989	18	--	1408
16	TS	ELLEN	20 AUG-24 AUG	5	45	993	15	--	1243
17	STY	FRAN	03 SEP-13 SEP	11	130	913	41	26	2616
18	TS	GEORGIA	09 SEP-15 SEP	7	40	992	26	--	1325
19	TY	HOPE	14 SEP-17 SEP	4	70	981	15	6	1604
20	TY	IRIS	14 SEP-21 SEP	8	75	967	29	11	756
21	TY	JOAN	19 SEP-24 SEP	6	70	---	20	2	1368
22	HR	KATE	21 SEP-02 OCT	(CENTRAL PACIFIC HURRICANE CENTER)					
23	STY	LOUISE	30 OCT-07 NOV	9	140	895	35	25	2754
24	TS	MARGE	06 NOV-11 NOV	6	60	977	21	0	1836
25	TS	NORA	03 DEC-08 DEC	6	45	992	21	--	456
26	TS	OPAL	09 DEC-10 DEC	2	35	996	7	--	338
			1976 TOTALS	131*			661	254	

INDIAN OCEAN AREA

CYCLONE	TYPE	NAME	PRD OF WRNG	CALENDAR DAYS OF WARNING	MAX SFC WIND	MIN OBS SLP	NO. OF WARNINGS TOTAL	NO. OF WARNINGS AS TY	DISTANCE TRAVELED
	TC	20-76	29 APR-02 MAY	4	50	---	7	--	403
	TC	22-76	02 JUN-03 JUN	2	40	---	3	--	163
	TC	23-76	10 SEP-11 SEP	2	40	---	5	--	324
	TC	25-76	15 OCT-17 OCT	3	50	---	6	--	372
	TC	30-76	30 DEC-02 JAN	4	55	---	7	--	511
			1976 TOTALS	15*			28	--	

*OVERLAPPING DAYS INCLUDED ONLY ONCE IN SUM

TABLE 4-2 FREQUENCY OF TROPICAL STORMS AND TYPHOONS BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AVERAGE (1945-58)	0.4	0.1	0.4	0.5	0.8	1.3	3.0	3.9	4.1	3.3	2.7	1.1	22.0
1959	0	1	1	1	0	0	3	6	6	4	2	2	26
1960	0	0	0	1	1	3	3	10	3	4	1	1	27
1961	1	1	1	1	3	2	5	4	6	5	1	1	31
1962	0	1	0	1	2	0	6	7	3	5	3	2	30
1963	0	0	0	1	1	3	4	3	5	5	0	3	25
1964	0	0	0	0	2	2	7	9	7	6	6	1	40
1965	2	2	1	1	2	3	5	6	7	2	2	1	34
1966	0	0	0	1	2	1	5	8	7	3	2	1	30
1967	1	0	2	1	1	1	6	8	7	4	3	1	35
1968	0	0	0	1	1	1	3	8	3	6	4	0	27
1969	1	0	1	1	0	0	3	4	3	3	2	1	19
1970	0	1	0	0	0	2	2	6	4	5	4	0	24
1971	1	0	1	3	4	2	8	4	6	4	2	0	35
1972	1	0	0	0	1	3	6	5	4	5	2	3	30
1973	0	0	0	0	0	0	7	5	2	4	3	0	21
1974	1	0	1	1	1	4	4	5	5	4	4	2	32
1975	1	0	0	0	0	0	2	4	5	5	3	0	20
1976	1	1	0	2	2	2	4	4	5	1	1	2	25
AVERAGE (1959-76)	0.6	0.4	0.4	0.9	1.3	1.6	4.6	5.9	4.9	4.2	2.5	1.2	28.4

TABLE 4-3 FREQUENCY OF TYPHOONS BY MONTH AND YEAR

YEAR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
AVERAGE (1945-58)	0.4	0.1	0.3	0.4	0.7	1.1	2.0	2.9	3.2	2.4	2.0	0.9	16.3
1959	0	0	0	1	0	0	1	5	3	3	2	1	20
1960	0	0	0	1	0	2	2	8	0	4	1	1	19
1961	0	0	1	0	2	1	3	3	5	3	1	1	20
1962	0	0	0	1	2	0	5	7	2	4	3	0	24
1963	0	0	0	1	1	2	3	3	3	4	0	2	19
1964	0	0	0	0	2	2	6	3	5	3	4	1	26
1965	1	0	0	1	2	2	4	3	5	2	1	0	21
1966	0	0	0	1	2	1	3	6	4	2	0	1	20
1967	0	0	1	1	0	1	3	4	4	3	3	0	20
1968	0	0	0	1	1	1	1	4	3	5	4	0	20
1969	1	0	0	1	0	0	2	3	2	3	1	0	13
1970	0	1	0	0	0	1	0	4	2	3	1	0	12
1971	0	0	0	3	1	2	6	3	5	3	1	0	24
1972	1	0	0	0	1	1	4	4	3	4	2	2	22
1973	0	0	0	0	0	0	4	2	2	4	0	0	12
1974	0	0	0	0	1	2	1	2	3	4	2	0	15
1975	1	0	0	0	0	0	1	3	4	3	2	0	14
1976	1	0	0	1	2	2	2	1	4	1	1	0	15
AVERAGE (1959-76)	0.3	0.1	0.1	0.7	0.9	1.1	2.8	3.8	3.3	3.2	1.6	.5	18.7

1976 saw a large number of days (53) of multiple-storm situations (Tables 4-1 and 4-7). As early as May simultaneous storms were generated when Olga and Pamela tracked across the western Pacific causing extensive damage to the Philippines and to Guam. June through September saw six additional two-storm situations and one three-storm situation. The long duration of several storms (e.g., Olga, Pamela and Fran), accounted for the near average number of warnings issued despite the less than average number of tropical cyclones (Table 4-7). Although the season started quickly, the latter part of the season tapered off earlier than normal. For 36 days in September and October, normally a very active period, there were no warnings issued. Not since 1958, when 30 days passed without a depression, has such a lull in activity occurred during this time of the year. It is interesting to note that twin storms in the northern and southern hemisphere occurred during April when Tropical Storm Nancy formed in the Pacific north of the equator and TC 19-76 did likewise south of the equator.

Most of the damage during 1976 was associated with three of the four super typhoons. Damage estimates to public and private property for Pamela and Fran combined exceeded one billion dollars. Fran also accounted for 133 dead in Japan. While Pamela was responsible for 10 dead on Truk, the super typhoon miraculously caused only one fatality as it passed over Guam. Therese sank 12 ships, and left 1300 homeless due to heavy rains in Southern Japan. During May, Olga caused enhanced monsoonal rains over the Philippines which led to over 200 deaths and thousands homeless. In addition, Typhoon Billie generated great waves which resulted in the drowning of 41 fishermen and swimmers as the storm passed through the Ryukyu Islands. It was subsequently responsible for 4 deaths in Taipei and caused millions of dollars of damage to facilities during its passage over northern Taiwan. Although Marie caused no known fatalities, it brought millions of dollars damage to crops and structures in the Palau Islands. In September Iris sank a Panamanian freighter and killed four as it tracked slowly across the South China Sea.

b. NORTH INDIAN OCEAN

During 1976 there were five tropical cyclones in the North Indian Ocean: three in the Bay of Bengal and two in the Arabian Sea. Table 4-5 presents the tropical cyclone distribution by month for 1976 and for the preceding five years. Except for the absence of activity during November, 1976 was climatologically normal. A total of 28 warnings were issued on the five cyclones, none of which exceeded 55 kt intensity. TC 25-76 occurred in the newly acquired JTWC area of responsibility, which this year was extended from 62E to the coast of Africa.

c. CENTRAL PACIFIC

The only Central Pacific tropical cyclone spawned during 1976 was in the month of September. A disturbance observed on the 20th ultimately developed into Hurricane Kate, and at one time became a threat to the Hawaiian Islands. It later recurved, passing northeast of Hawaii. Kate ended a 24 month absence of tropical cyclone activity in the Central Pacific, being the first hurricane since August 1974.

TABLE 4-4.

PACIFIC AREA

TROPICAL CYCLONE FORMATION ALERT SUMMARY

YEAR	NUMBER OF ALERT SYSTEMS	ALERT SYSTEMS WHICH BECAME NUMBERED TROPICAL CYCLONES	TOTAL NUMBERED TROPICAL CYCLONES	DEVELOPMENT RATE
1972	41	29	32	71%
1973	26	22	23	85%
1974	35	30	36	86%
1975	34	25	25	74%
1976	34	25	25	74%

MONTHLY DISTRIBUTION

	J	F	M	A	M	J	J	A	S	O	N	D
FORMATION ALERTS	2	2	1	2	2	3	6	4	6	2	1	3

TABLE 4-5. FREQUENCY OF NORTH INDIAN OCEAN CYCLONES BY MONTH AND YEAR.

YEAR*	J	F	M	A	M	J	J	A	S	O	N	D	TOTAL
1971	0	0	0	0	0	0	0	0	0	1	1	0	2
1972	0	0	0	1	0	0	0	0	2	0	1	0	4
1973	0	0	0	0	0	0	0	0	0	1	2	1	4
1974	0	0	0	0	0	0	0	0	0	0	1	0	1
1975	1	0	0	0	2	0	0	0	0	1	2	0	6
1976	0	0	0	1	0	1	0	0	1	1	0	1	5
AVG**	0.1	***	0.1	0.3	0.7	0.7	0.6	0.4	0.5	1.0	1.1	0.5	5.7

*1971-1974 REPRESENT BAY OF BENGAL CYCLONES ONLY
**1877-1960 AVERAGE (INCLUDING ARABIAN SEA) MARINERS WORLDWIDE CLIMATIC GUIDE TO TROPICAL STORMS AT SEA (H. L. CRUTCHER AND R. G. QUAYLE)
***LESS THAN 0.05 PER MONTH

TABLE 4-6. FREQUENCY OF CENTRAL PACIFIC STORMS BY MONTH AND YEAR. (NUMBER IN PARENTHESIS INDICATE STORMS REACHING HURRICANE INTENSITY)

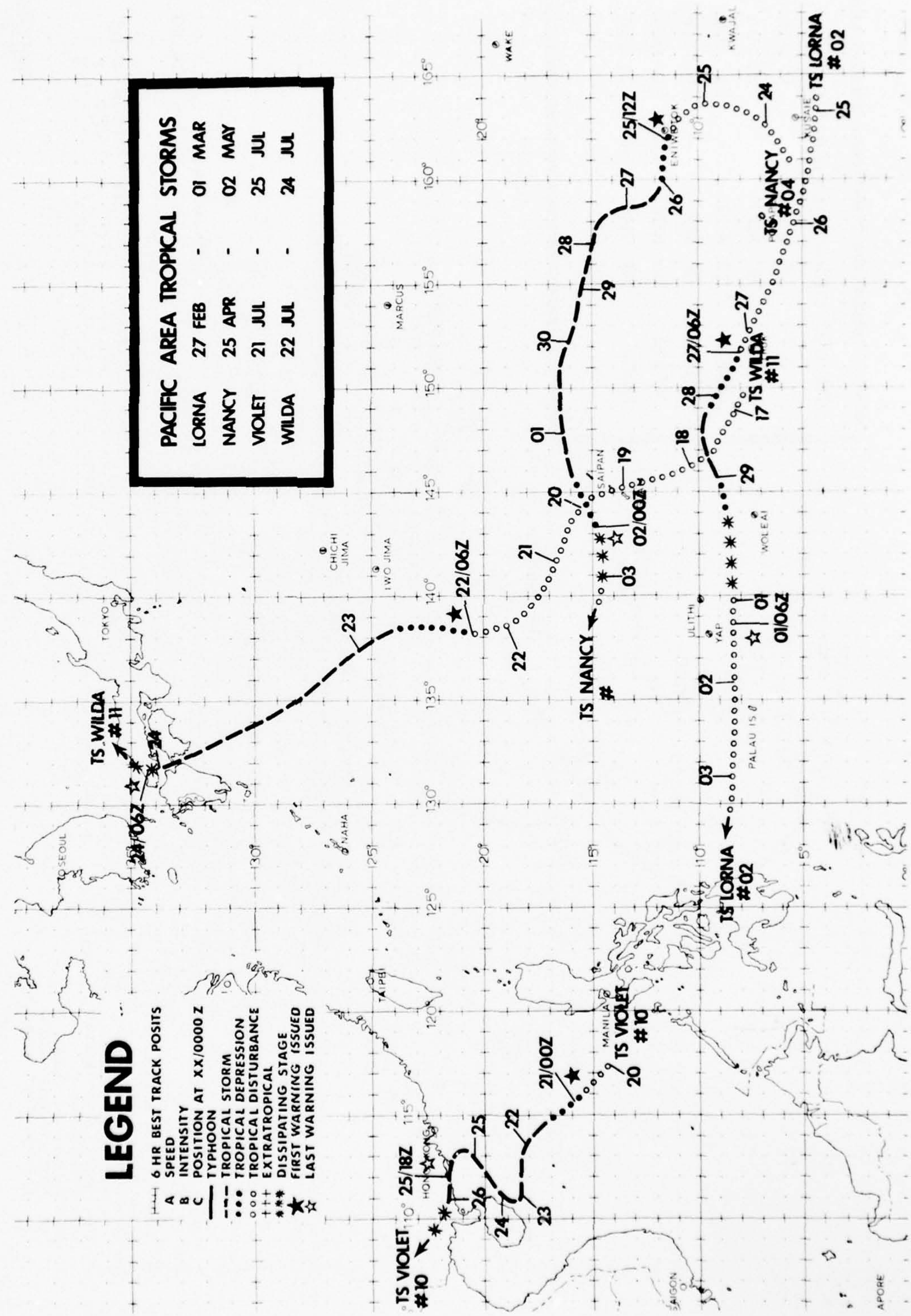
	JAN-JUN	JUL	AUG	SEP	OCT	NOV-DEC
1967	0	0	0	0	1	0
1968	0	0	2	0	0	0
1969	0	0	0	0	0	0
1970	0	0	1	0	0	0
1971	0	1 (1)	1	0	0	0
1972	0	0	3 (1)	1	0	0
1973	0	1 (1)	0	0	0	0
1974	0	0	2 (1)	0	0	0
1975	0	0	0	0	0	0
1976	0	0	0	1 (1)	0	0
AVERAGE	0	.2(.2)	.9(.3)	.2(.2)	.1	0

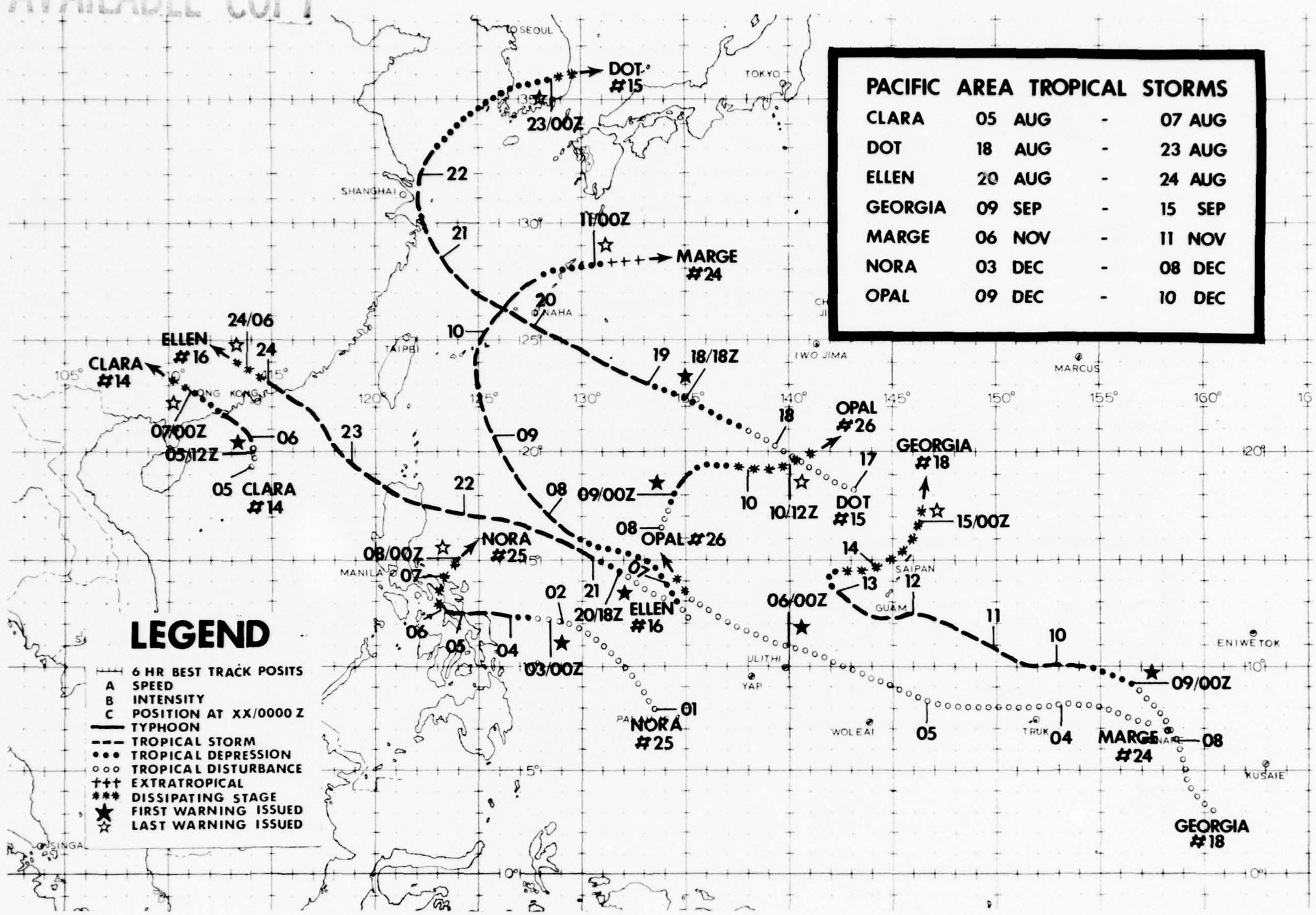
TABLE 4-7. SUMMARY OF JTWC WARNINGS 1959-1976.

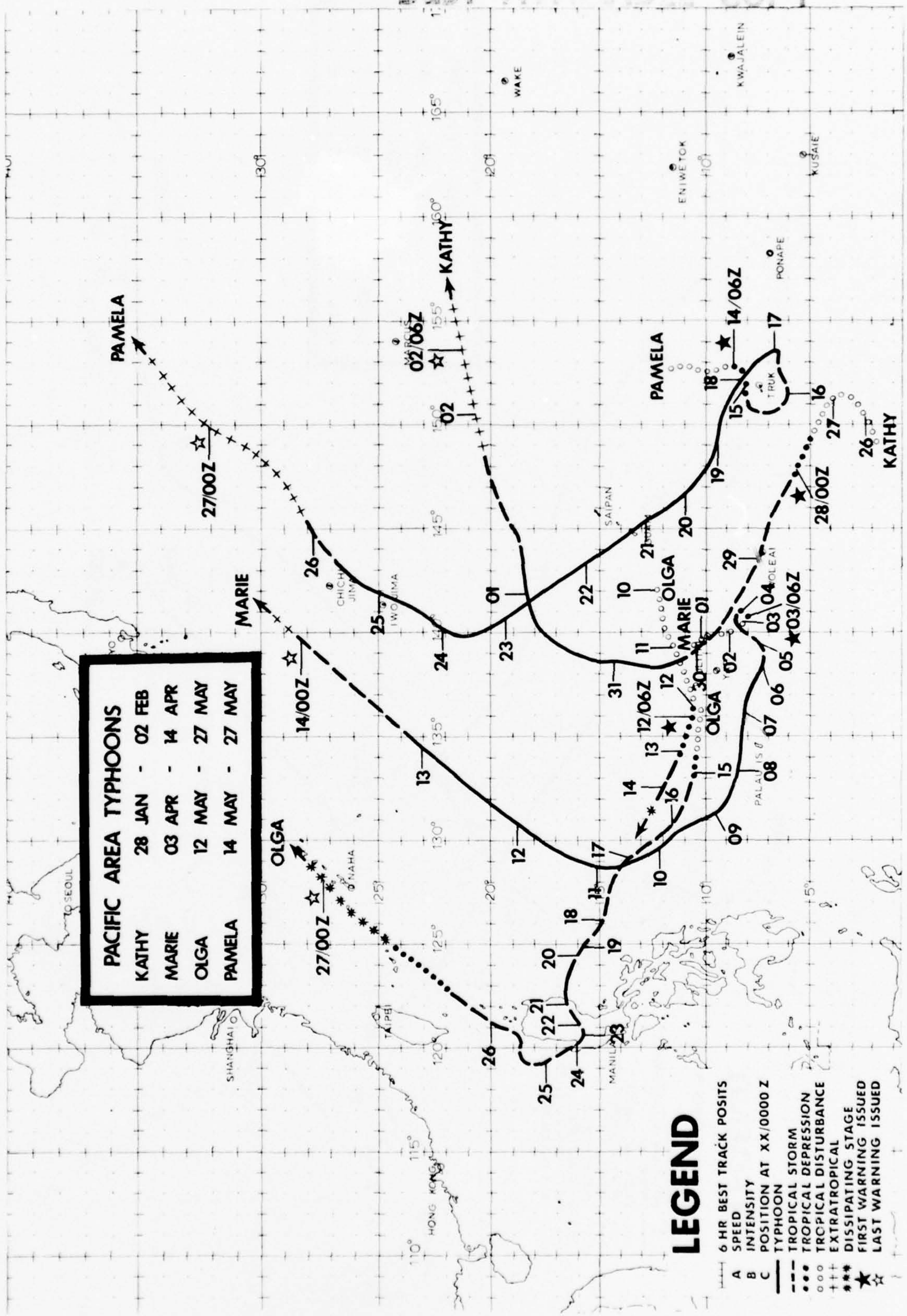
	WESTERN NORTH PACIFIC		NORTH INDIAN OCEAN		CENTRAL NORTH PACIFIC	
	1976	AVERAGE 1959-75	1976	AVERAGE 1971-75*	1976	AVERAGE 1971-75
TOTAL NUMBER OF WARNINGS	661	680	28	25	42	33
CALENDAR DAYS OF WARNINGS	131	143	13	16	12	10
NUMBER OF WARNING DAYS WITH TWO CYCLONES	49	48	0	1	0	1
NUMBER OF WARNING DAYS WITH THREE OR MORE CYCLONES	4	9	0	0	0	0
TROPICAL DEPRESSIONS	0	5	-	-	0	1
TROPICAL STORMS	11	11	-	-	0	1
TYPHOONS/HURRICANES	14	19	-	-	1	1
I.O. TROPICAL CYCLONES	-	-	5	4	0	-
TOTAL TROPICAL CYCLONES	25	35	5	4	1	3

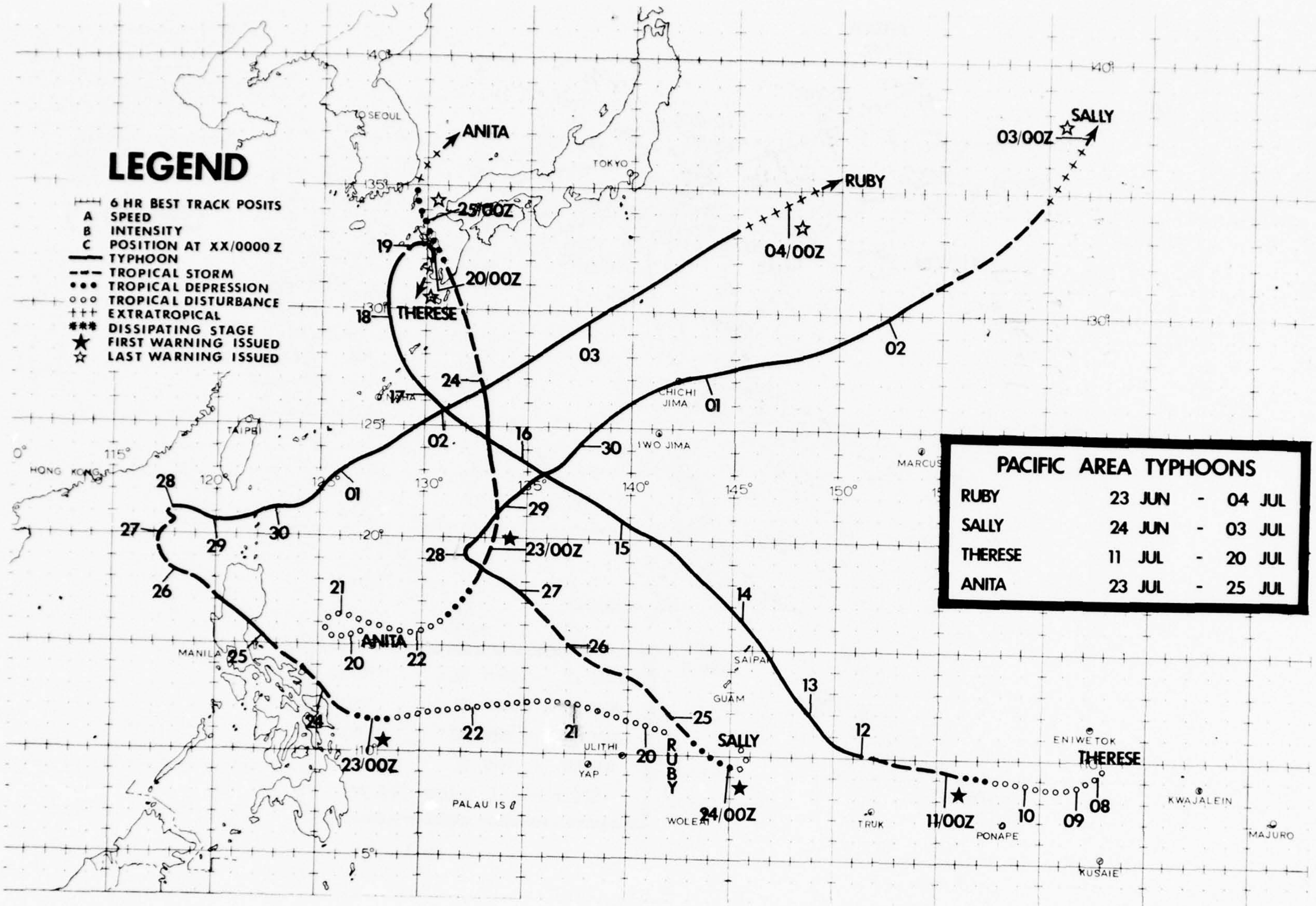
*BAY OF BENGAL ONLY 1971-1974

2. WESTERN NORTH PACIFIC TROPICAL CYCLONES




PACIFIC AREA TROPICAL STORMS
CLARA 05 AUG - 07 AUG
DOT 18 AUG - 23 AUG
ELLEN 20 AUG - 24 AUG
GEORGIA 09 SEP - 15 SEP
MARGE 06 NOV - 11 NOV
NORA 03 DEC - 08 DEC
OPAL 09 DEC - 10 DEC
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
SEOUL
TOKYO
SHANGHAI
TAIPEI
HONG KONG
MANILA
NAHA
IWO JIMA
MARCUS
SAIPAN
GUAM
ULITHI
YAP
WOLEAI
TRUK
ENIWETOK
KUSAIE
CLARA #14
ELLEN #16
DOT #15
MARGE #24
GEORGIA #18
OPAL #26
NORA #25


PACIFIC AREA TYPHOONS
KATHY 28 JAN - 02 FEB
MARIE 03 APR - 14 APR
OLGA 12 MAY - 27 MAY
PAMELA 14 MAY - 27 MAY
LEGEND
A B C 6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
PAMELA
KATHY
MARIE
OLGA
27/00Z
02/06Z
14/00Z
12/06Z
03/06Z
14/06Z
28/00Z
SEOUL
SHANGHAI
TAIPEI
NAHA
HONG KONG
MANILA
IWO JIMA
CHICHI JIMA
SAIPAN
WAKE
KWAJALEIN
ENIWETOK
KUSAIE
PONAPE
TRUK
WOLEAI
PALAU IS


LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
PACIFIC AREA TYPHOONS
RUBY 23 JUN - 04 JUL
SALLY 24 JUN - 03 JUL
THERESE 11 JUL - 20 JUL
ANITA 23 JUL - 25 JUL
SEOUL
TOKYO
TAIPEI
HONG KONG
MANILA
CHICHI JIMA
IWO JIMA
MARCUS
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
TRUK
PONAPE
ENIWETOK
KWAJALEIN
MAJURO
KUSAIE
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THERESE
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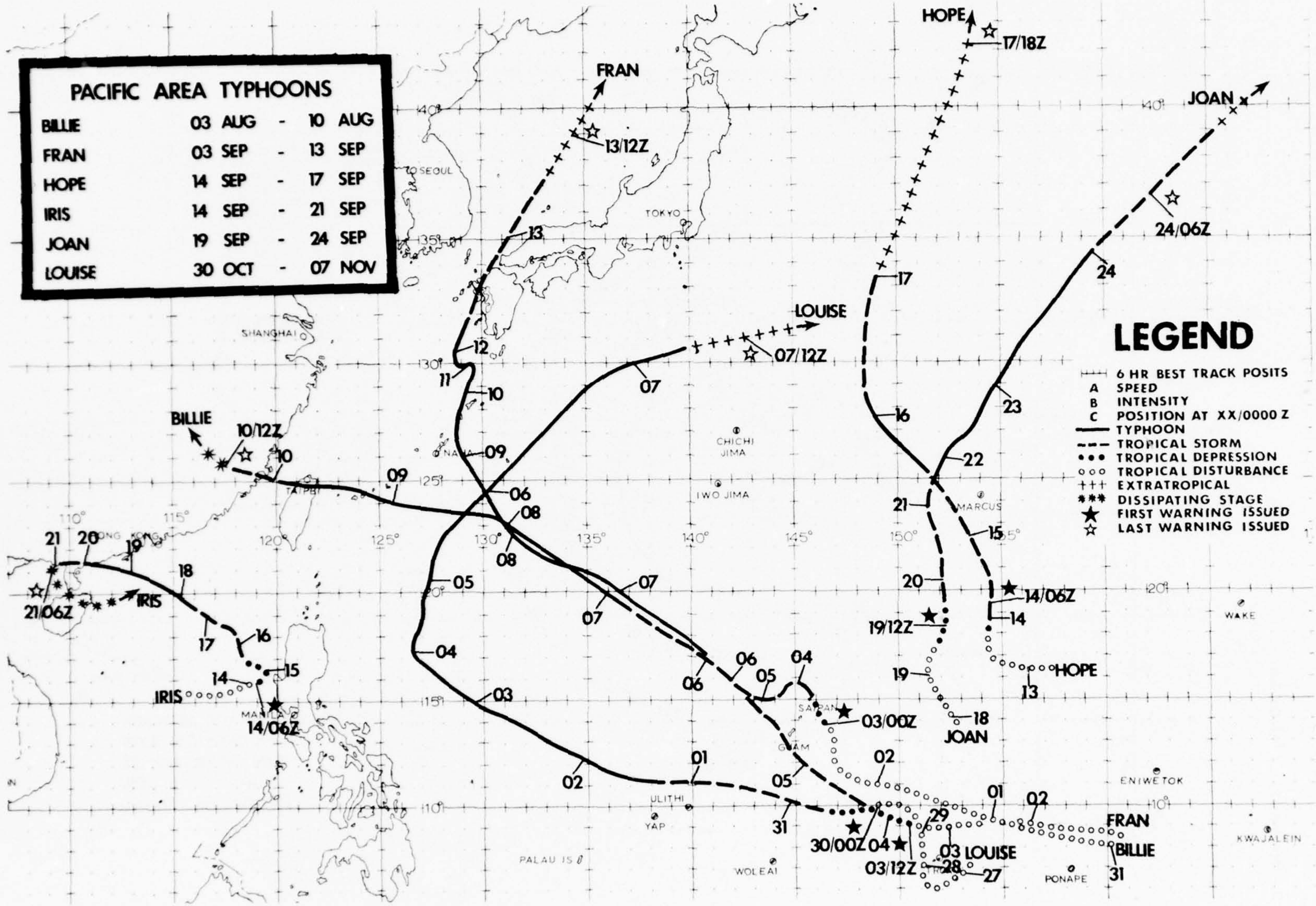
PACIFIC AREA TYPHOONS
BILLIE 03 AUG - 10 AUG
FRAN 03 SEP - 13 SEP
HOPE 14 SEP - 17 SEP
IRIS 14 SEP - 21 SEP
JOAN 19 SEP - 24 SEP
LOUISE 30 OCT - 07 NOV
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
FRAN
13/12Z
HOPE
17/18Z
JOAN
24/06Z
LOUISE
07/12Z
BILLIE
10/12Z
IRIS
21/06Z
14/06Z
19/12Z
03/00Z
30/00Z
03/12Z
SEOUL
TOKYO
SHANGHAI
NAHA
TAIPEI
HONG KONG
MANILA
CHICHI JIMA
IWO JIMA
MARCUS
WAKE
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
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KWAJALEIN
110°
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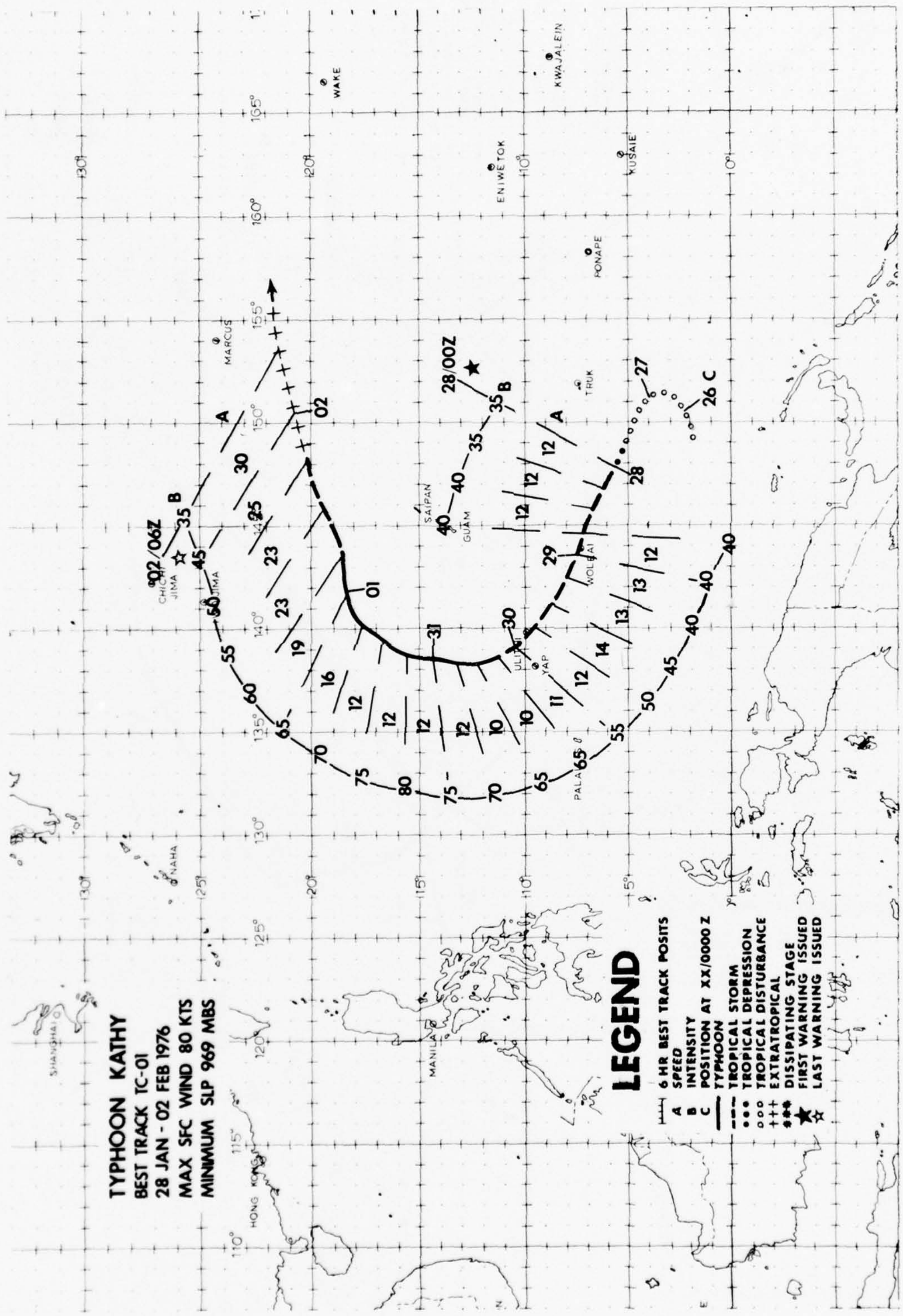
125°
130°
135°
140°
145°
150°
155°
10°
15°
20°
25°
30°
35°
40°

3. INDIVIDUAL TYPHOONS



KATHY

The first typhoon of the 1976 season, a January storm, was initially detected by ship reports on the morning of the 25th as a cyclonic circulation unusually close to the equator (2N - 149E). By the morning of the 26th meteorological satellite data indicated a region of intense convective activity centered near 2.3N - 149.0E. During the next three days, the disturbance destined to become Typhoon Kathy slowly intensified as it moved northeastward and then northwestward (Fig. 4-1). On the morning of the 29th reconnaissance aircraft indicated that the circulation was nearly at tropical storm intensity, and the first warning was issued at 0000Z on the 28th. During the next 48 hours, Tropical Storm Kathy moved northwestward at 12 to 13 kt. Reconnaissance aircraft at 2143Z on the 29th reported the center of Kathy over Ulithi Atoll, and further indicated the absence of an eye or wall cloud. At 0000Z on the 30th, when Kathy was 40 nm to the northwest, Ulithi recorded winds of 25 kt and a sea level pressure of 1001.2 mb.

Later on the 30th a deep mid-latitude trough moved eastward into the Philippine Sea, weakening the mid-tropospheric subtropical ridge and providing an efficient outflow channel to the mid-latitude westerlies. In response, Kathy intensified into a typhoon and moved northward, slowing to 10 kt. By that evening, the typhoon was drifting north through the weakness in the ridge, still intensifying slowly.

Late on the 30th, Kathy passed the point of recurvature and began to move north-northeastward as the slow moving mid-latitude trough to the west dug deeper toward the tropics (Fig. 4-2). Twelve hours later it attained its maximum intensity of 80 kt. At 0504Z on the 31st reconnaissance aircraft recorded maximum flight level winds of 90 kt and a minimum sea level pressure of 969 mb. At 0600Z a ship, JQFN, reported 55 kt winds 160 nm northeast of Kathy.

Embedded in westerly flow Kathy began to accelerate to the northeast. By the afternoon of February 1st the storm was on an east-northeast track moving at more than 20 kt, and had weakened into a tropical storm. The strong westerly shear and cooler temperatures rapidly stripped the storm of its tropical characteristics, and by 1800Z on the 1st Kathy had become extratropical. This extratropical low later produced copious precipitation over the Hawaiian Islands with Wailua, Oahu recording 18.81 inches of rain during the 6th, 7th and 8th of February.

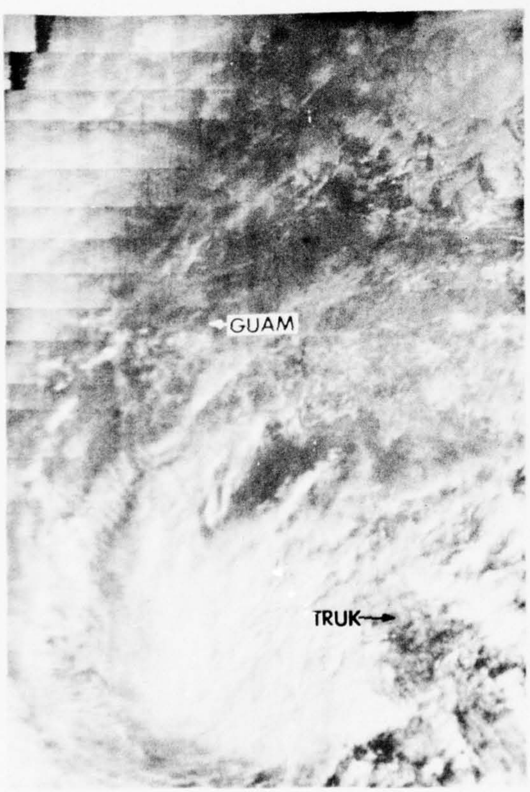


FIGURE 4-1. *Kathy during early development 250 nm south of Truk, 26 January 1976, 2059Z. (DMSP imagery)*

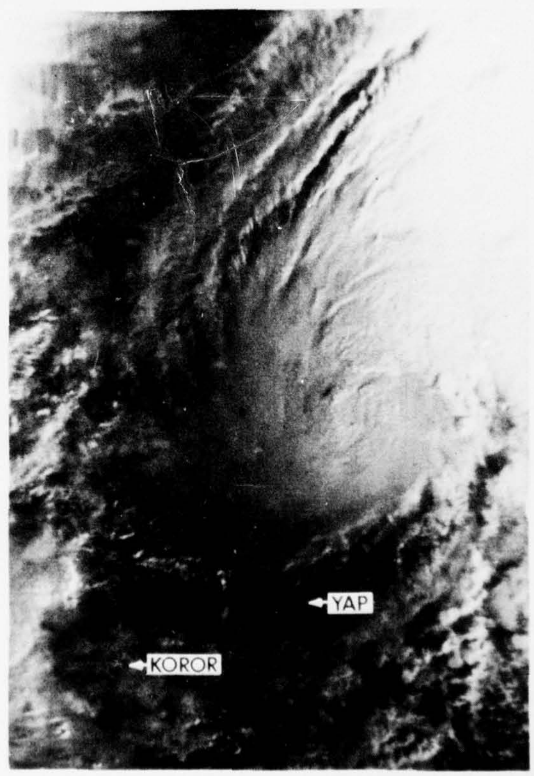
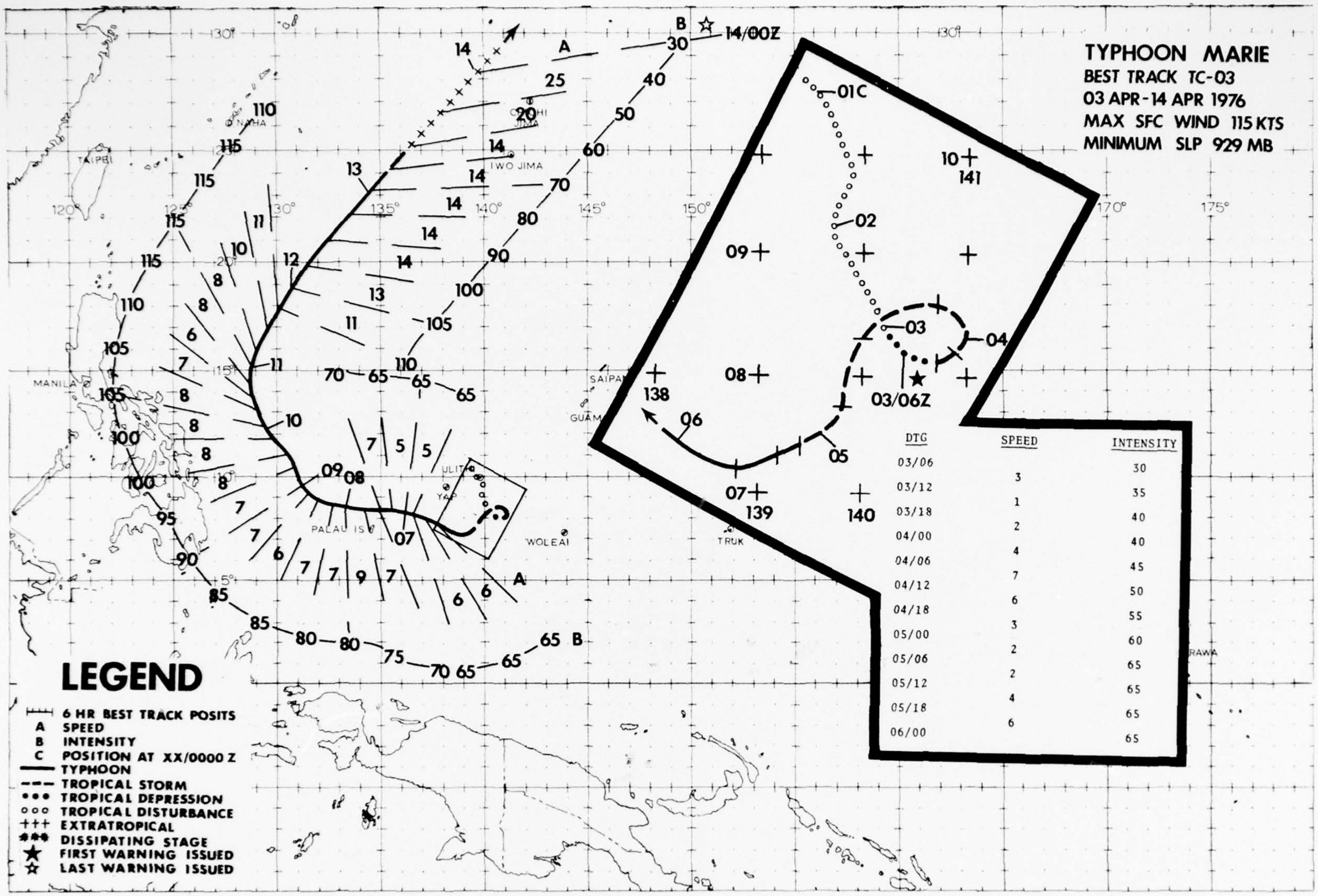


FIGURE 4-2. *Typhoon Kathy just after recurvature and 8 hours prior to attaining its 80 kt peak intensity 260 nm north of Yap, 30 January 1976, 2152Z. (DMSP imagery)*


TYPHOON MARIE
BEST TRACK TC-03
03 APR-14 APR 1976
MAX SFC WIND 115 KTS
MINIMUM SLP 929 MB
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
DTG SPEED INTENSITY
03/06 30
03/12 3 35
03/18 1 40
04/00 2 40
04/06 4 45
04/12 7 50
04/18 6 55
05/00 3 60
05/06 2 65
05/12 2 65
05/18 4 65
06/00 6 65
14/00Z
03/06Z
MANILA
TAIPEI
NAHA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
TRUK

On the 1st of April a tropical disturbance was detected by satellite near 10N - 140E. Synoptic data revealed a weak surface cyclonic circulation with an associated upper level anticyclone. The system drifted slowly southward for the next 2 days. At 0030Z on the 3rd a formation alert was issued when synoptic data indicated the system had intensified to 25 kt, and increasing upper level outflow to the north promised good potential for further intensification. At 0600Z on the 3rd the first warning was issued. Six hours later the system was upgraded to Tropical Storm Marie when synoptic data confirmed aircraft reports of 35 kt winds.

Influenced by weak steering flow, the storm turned eastward in a counterclockwise loop, and during the evening of the 4th began taking a slow, southerly heading. Tropical Storm Marie intensified, and by 0600Z on the 5th had attained typhoon strength. Twelve hours later the typhoon had acquired a 6 kt movement toward the west-northwest, and for the next 48 hours maintained 65 kt winds.

FIGURE 4-3. *Moonlight image of Typhoon Marie near 70 kt intensity 70 nm north-northeast of Koror, Palau Islands, 7 April 1976, 1042Z. (DMSP imagery)*

On the evening of the 7th, the typhoon once again began to intensify, as upper tropospheric winds over the Philippine Islands backed, indicating deeper troughing to the west and a more efficient link of the storm's outflow channel with the mid-latitude westerlies (Fig. 4-3). This intensification continued slowly during the subsequent 84 hours at a rate of about ½ mb per hour.

At 1500Z on the 7th Typhoon Marie passed 40 nm north of Palau with peak gusts of 75 kt and a minimum sea level pressure of 993 mb recorded at Koror. While no deaths or injuries were reported, damage of more than $4 million was incurred on the Palau Islands. Crop destruction was extensive as was damage to buildings and public utilities. As a result, Palau was declared a major disaster area.

By 0000Z on the 8th a weakness in the subtropical ridge appeared near the eastern coast of the Philippines. In response, Marie turned northward and recurved. During the typhoon's western-most position at 2100Z on the 10th, the system reached its maximum intensity of 115 kt (Fig. 4-4). The lowest sea-level pressure was 929 mb recorded by aircraft at 2031Z on the 10th. Typhoon Marie maintained 115 kt winds for 24 hours as its northeast movement increased to 11 kt. By 1800Z on the 11th Marie began to weaken while accelerating on a northeast track, closely following the 700 mb flow. Two days later the final warning was issued as Marie became extratropical.

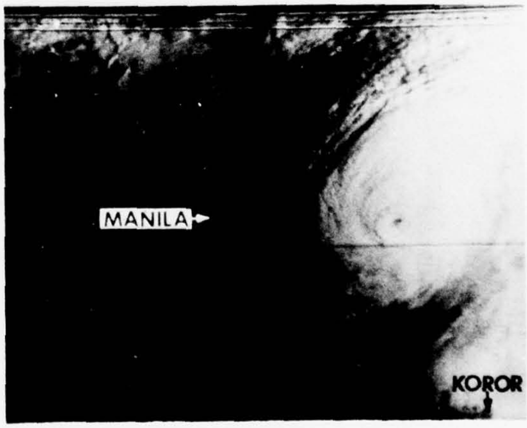
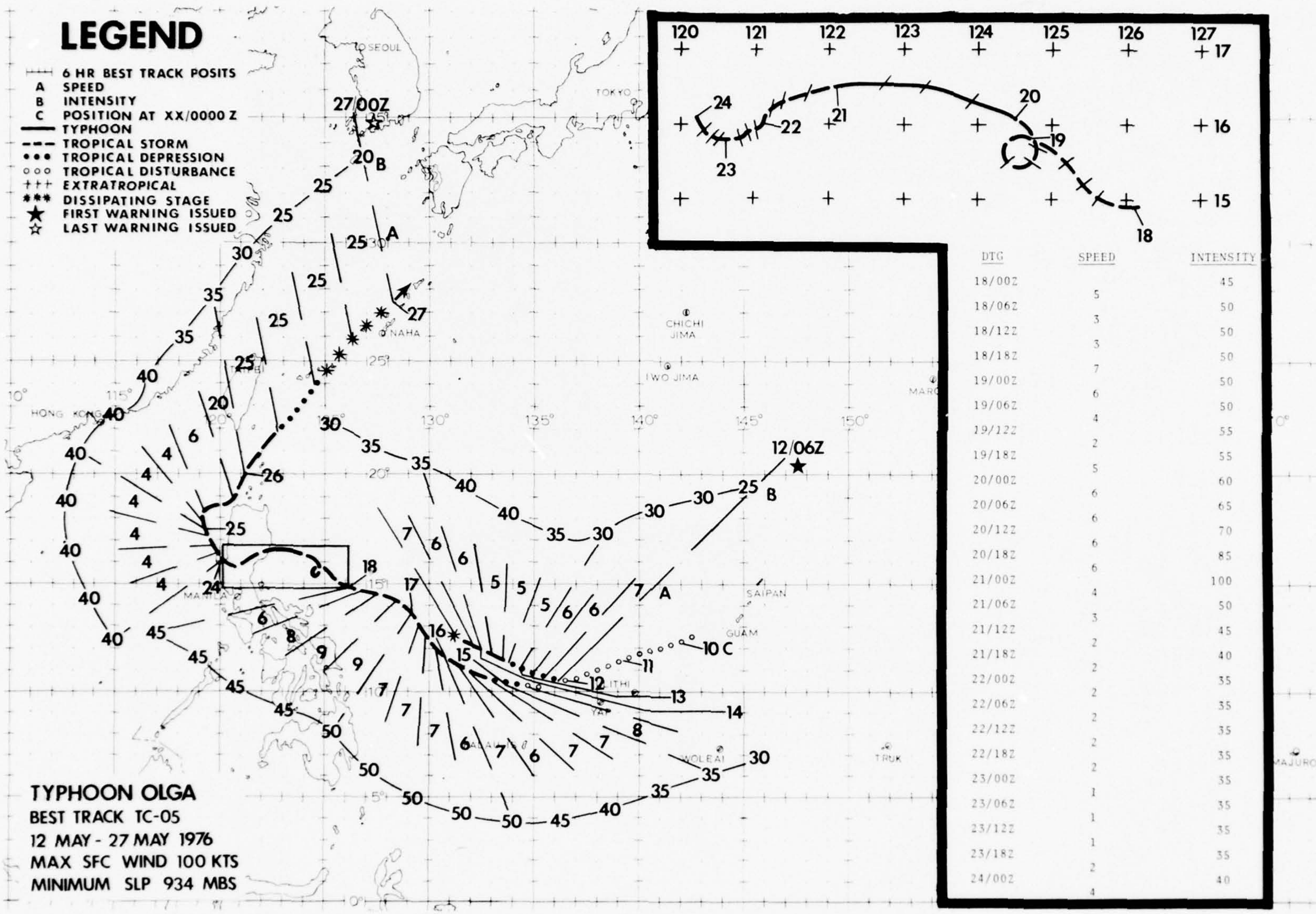


FIGURE 4-4. *Typhoon Marie at point of recurvature with winds at peak intensity 450 nm east of Manila, 10 April 1976, 2251Z. (DMSP imagery)*



DTG	SPEED	INTENSITY
18/00Z	5	45
18/06Z	3	50
18/12Z	3	50
18/18Z	7	50
19/00Z	6	50
19/06Z	4	50
19/12Z	2	55
19/18Z	5	55
20/00Z	6	60
20/06Z	6	65
20/12Z	6	70
20/18Z	6	85
21/00Z	4	100
21/06Z	3	50
21/12Z	2	45
21/18Z	2	40
22/00Z	2	35
22/06Z	2	35
22/12Z	2	35
22/18Z	2	35
23/00Z	1	35
23/06Z	1	35
23/12Z	1	35
23/18Z	2	35
24/00Z	4	40

Typhoon Olga originated within a very active trough near 10N and between 130 and 155E. As early as 4 May, several surface circulations were evident throughout this zone. By the 12th, a center analyzed near 10N - 140E showed indications that it would be the dominant circulation, and the first warning was issued at 0600Z on the 12th. From the onset, Olga was a unique system, having diffuse characteristics which it maintained throughout its life. One such trait was the lack of vertical stacking, observed when comparing satellite and aircraft positions. The low level circulation was often ill defined, and on several occasions multiple circulations could be identified.

Originally, Olga was tracked by satellite as a tropical disturbance moving toward the southwest, following the center of the upper level anticyclone. After 1200Z on the 12th a more climatological track toward the west-northwest was observed, but at half the speed normal for this time of year. This movement, along the southern edge of the subtropical ridge, persisted through the afternoon of the 13th when Olga was upgraded to a tropical storm. Later that night satellite data indicated the presence of a second circulation 120 nm to the east of the storm center. By the 14th the original center had dissipated and the convective energy had consolidated around this second center. The relocated system then proceeded toward the west-northwest while it slowly intensified, and attained tropical storm intensity for the second time. On the 16th Olga responded to a short wave trough in the westerlies and moved toward the north. However, on the 17th the storm resumed its west-northwest heading as the short wave progressed rapidly toward the east. It was at this point that satellite data indicated Olga was entering an unfavorable upper level shearing environment provided by a 200 mb ridge over Southeast Asia, which persisted throughout the remainder of Olga's life.

On the 18th Olga began to slow its forward movement in response to a long wave trough moving off the east coast of China. At this point it was expected that the storm would recurve ahead of the trough, but instead, Olga began a counterclockwise loop, and slowly intensified despite the unfavorable upper level shear. On the 20th Olga completed its loop and attained typhoon intensity. After completing the loop the storm tracked toward the west at 6 kt, continuing to intensify. Between aircraft reports at 0330Z and 1947Z on the 20th, there was a drop in the central pressure of 44 mb (from 978 to 934 mb), a rate of 2.7 mb per hour (Fig. 4-5). With this rapid deepening, Olga made landfall on the east side of Luzon near 16.5N at approximately 0000Z on the 21st with winds estimated at 100 kt.

After landfall the small core of high winds subsided quickly (Fig. 4-6). For the next 24 hours Olga's center meandered toward the southwest along the east coast of Luzon passing near Bayler Bay with winds of 45 kt at storm center. Seeking the path of least resistance, Olga tracked through the Luzon lowlands during the next 48 hours exiting the island through Lingayen Gulf on the 24th. During its slow journey across Luzon, at 2 to 4 kt, Olga enhanced the southwest monsoon over southern Luzon, bringing rains in excess of 50 inches at Cubi Point and perhaps higher at other areas. The resulting floods contributed to over 200 deaths and thousands of homeless. For the next 24 hours Olga tracked toward the northwest through the Gulf reintensifying to 40 kt. On the 25th, the low level circulation separated from the hard core convection and tracked toward the northeast at an accelerated rate. Olga dissipated to the west of Okinawa on the 27th as it was absorbed into a subtropical disturbance west of the island.

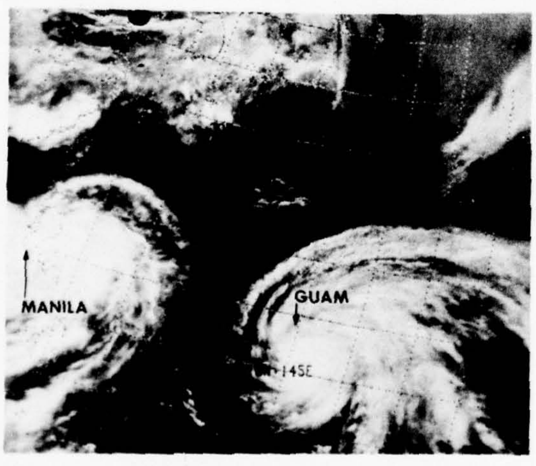


FIGURE 4-5. *Typhoon Olga (left) at 70 kt intensity 85 nm east of Luzon begins rapid deepening as Typhoon Pamela moves toward Guam, 20 May 1976, 1109Z. (NOAA-4 imagery)*

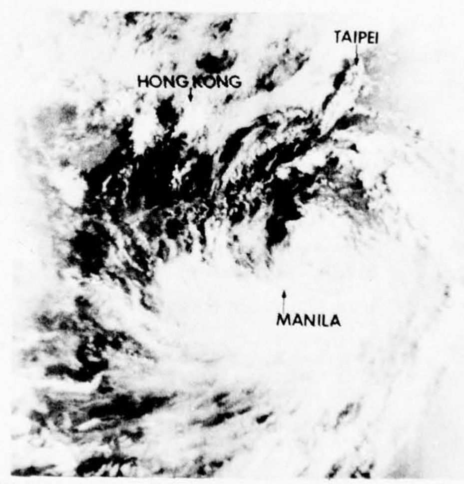
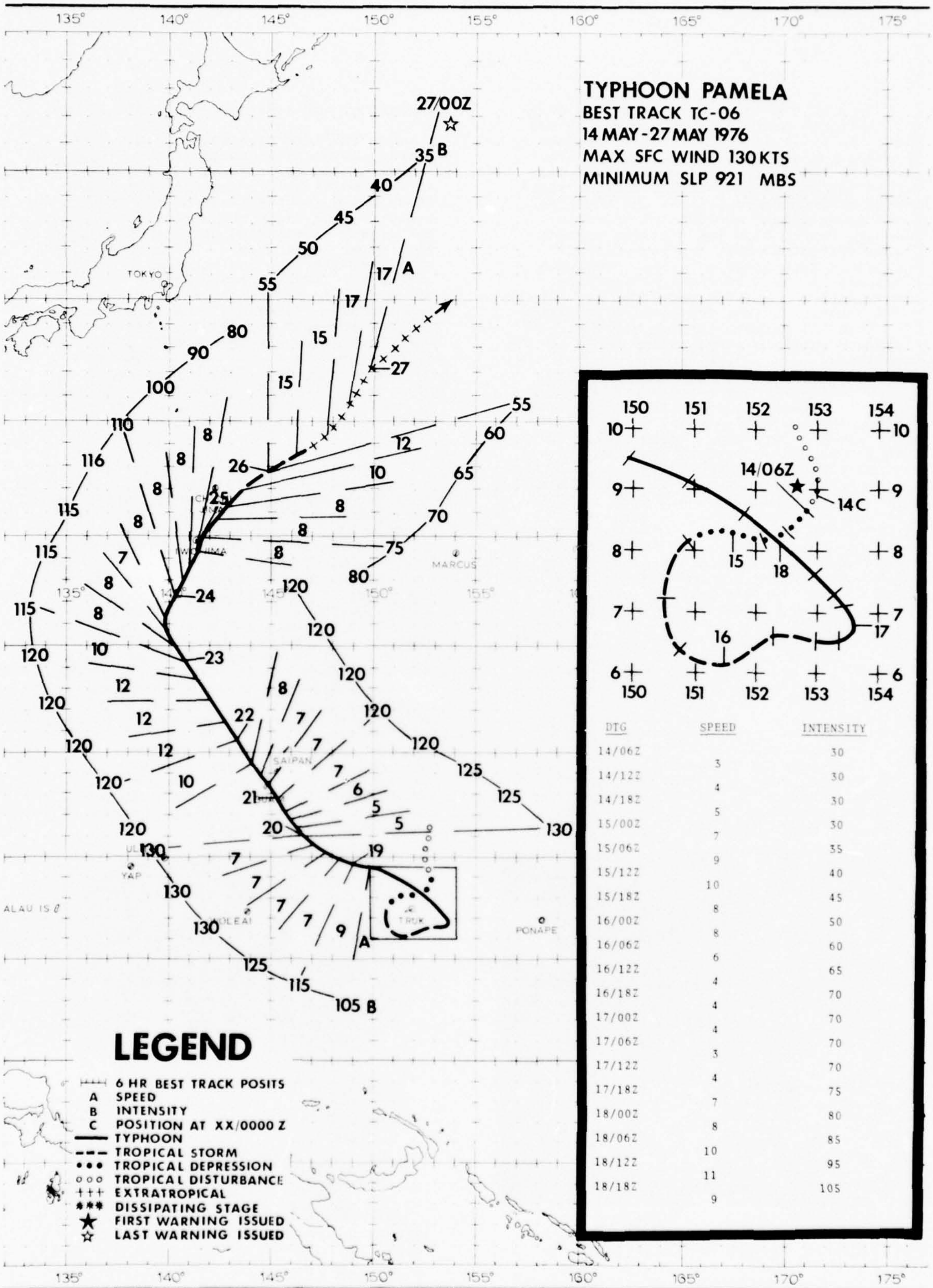


FIGURE 4-6. *Olga at 40 kt intensity 95 nm north of Manila some 18 hours after moving inland over Luzon, 21 May 1976, 2304Z. (DMSP imagery)*



DTG	SPEED	INTENSITY
14/06Z	3	30
14/12Z	4	30
14/18Z	5	30
15/00Z	7	30
15/06Z	9	35
15/12Z	10	40
15/18Z	8	45
16/00Z	8	50
16/06Z	6	60
16/12Z	4	65
16/18Z	4	70
17/00Z	4	70
17/06Z	3	70
17/12Z	4	70
17/18Z	7	75
18/00Z	8	80
18/06Z	10	85
18/12Z	11	95
18/18Z	9	105

Pamela, the fourth typhoon of 1976, was also the first super typhoon of the season. Destined to become one of the more destructive storms of history, Pamela was first detected on the morning of 13 May as a tropical disturbance near the eastern edge of the near equatorial trough approximately 230 nm north of Truk. For the next 24 hours the disturbance was difficult to track with the sparce synoptic data available, however, satellite pictures indicated a general southward movement. On the morning of the 14th the disturbance began to move to the southwest and at 0600Z it was upgraded to TD 06. By that evening the depression was moving west at 5 to 7 kt. At 0339Z on the 14th aircraft indicated surface winds near 40 kt and a sea level pressure of 998 mb; at 0600Z TD 06 was upgraded to Tropi al Storm Pamela. Shortly thereafter Pamela began to move to the south at 9 to 10 kt, intensifying to 45 kt by 1800Z.

The next morning satellite data showed that Pamela was moving toward the south-southeast. Truk synoptic data at 1800Z indicated a sea level pressure of 998.6 mb, a 7.1 mb fall over the previous 24 hours. By 2200Z Truk had a surface pressure of 997.9 mb and northeasterly winds of 30 kt. At this time Pamela was forecast to trace a counter-clockwise loop around Truk. At 0348Z on the 16th an aircraft fixed Pamela 75 nm southeast of Truk and proceeded on a northeast track gathering peripheral information. Later that afternoon reports indicated destructive winds at Satawan Atoll (91338). The aircraft was diverted to the region of the atoll where the crew observed an extensive area of 55 to 65 kt flight level winds with surface winds estimated as high as 100 kt. At 0740Z on the 16th warning number 09 was amended to upgrade the storm to Typhoon Pamela. Pamela at this time was a small but intense typhoon (Fig. 4-7). The maximum winds were located on the south side of the 150 nm diameter central dense overcast.

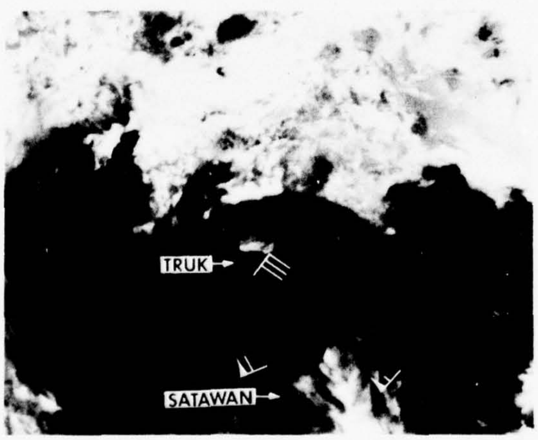


FIGURE 4-7. *Infrared photograph of Pamela near 65 kt 75 nm southeast of Truk, 16 May 1976, 0938Z. Wind barbs represent 700 mb winds observed by reconnaissance aircraft from 0600Z to 1000Z. (DMSP imagery)*

During the next 36 hours Pamela continued to intensify as it moved erratically at 3 to 6 kt, turning northwestward on the morning of the 17th. From the morning of the 16th until the morning of the 18th, Satawan Atoll continued to be buffeted with southwesterly and southerly surface winds of 50 to 55 kt. Damage was widespread on the tiny atoll, but no deaths were reported.

By the morning of the 18th Pamela had accelerated to 7 kt, passing within 50 nm of Truk. A minimum sea level pressure of 993.4 mb was recorded at 0400Z and a peak wind of 49 kt was observed an hour later. At 0327Z aircraft found maximum surface winds of 85 kt, a minimum pressure of 951 mb and a circular eye 10 nm in diameter. From the afternoon of the 17th to the afternoon of the 18th Truk recorded nearly 11 inches of rain which initiated mud slides killing 10 persons. Massive damage was inflicted on crops.

Pamela's erratic movements can be attributed to the influence of the Tropical Upper Tropospheric Trough (TUTT). On the 13th the TUTT began to establish itself north of the disturbance. Through the evening of the 15th the TUTT moved steadily south-southwestward, applying pressure to the upper anticyclone above Pamela. This pressure accounted for Pamela's southward and westwa: l movement, and for the cyclone's slow intensification. By the morning of the 16th the TUTT had receded northward relieving the southward pressure, enhancing outflow and allowing the tropical storm to intensify. This release of pressure would have allowed the storm to move toward a climatological west-northwest track, however, by the 15th, an induced mid-tropospheric high pressure cell between Pamela and Typhoon Olga (in the Philippine Sea) had intensified, building eastward and forcing Pamela toward the east. By early morning on the 17th Olga had moved considerably to the west, the ridge had relaxed, and Pamela swung north and then northwest completing the loop around Truk.

From 0600Z on the 18th to 0600Z on the 19th Typhoon Pamela moved toward the northwest at an average speed of 9 kt, intensifying at a rate of 10 kt each 6 hours. At 1200Z on the 19th Pamela reached its super typhoon intensity of 130 kt with gusts to 160 kt (see photograph on front cover), which it maintained for 18 hours. At 2112Z on the 19th reconnaissance aircraft reported the minimum measured sea level pressure at 921 mb while observing concentric eye wall clouds with diameters of 10 and 20 nm. By the afternoon of the 20th, an eastward moving short-wave trough had created a weakness in the mid-tropospheric subtropical ridge north of Pamela. This, coupled with an elongated high pressure cell east of the typhoon, forced Pamela to acquire the north-northwestward track which would bring it over Guam.

A possible threat to the island had been identified as early as the 16th, and all forecasts subsequently issued indicated that Pamela was expected to pass within 100 nm of Guam. At 0450Z on the 18th the Commander, Naval Forces Marianas (COMNAVMAR) set Typhoon

Condition III for Guam. At 2330Z on the 18th COMNAVMAR set Typhoon Condition II and at 2330Z on the 19th Condition I was set.

During the next 24 hours northeasterly winds on Guam slowly intensified as Pamela approached the island. At 1800Z on the 20th the National Weather Service (NWS) at Taguac (91217) reported 73 kt winds at the 3000 ft level while surface winds were only 30 kt (Fig. 4-8). At 0315Z on the 21st reconnaissance aircraft from the 54th Weather Reconnaissance Squadron, Andersen AFB, Guam fixed the typhoon 30 nm southeast of the island. Less than 90 minutes later the northwestern edge of the eye was over the southeast coast of Guam.

The large, relatively calm eye, some 20 nm in diameter, required up to three hours to cross the center of the island (Fig. 4-9). Both Andersen AFB and the NWS at Taguac continually experienced winds exceeding 50 kt as the eye passed south of these stations. Most installations which had wind indicators lost their anemometers prior to the peak

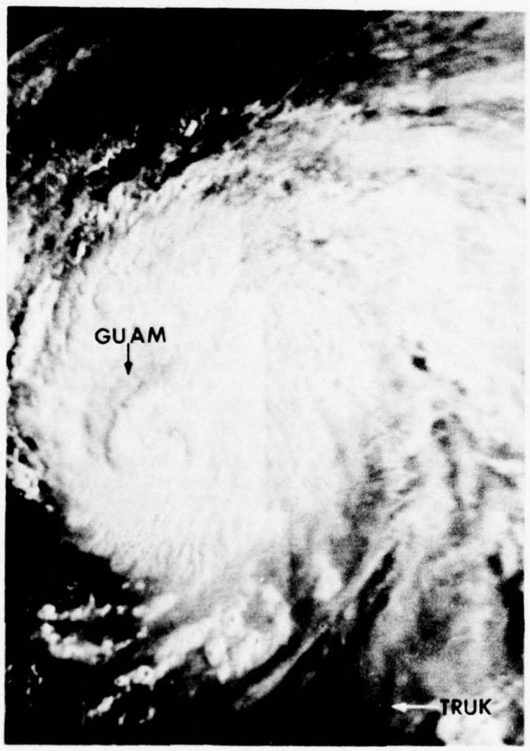


FIGURE 4-8. *Typhoon Pamela at 120 kt intensity 65 nm southeast of Guam, 20 May 1976, 2134Z. (DMSP imagery)*

winds. The maximum observed wind gust was 138 kt reported by the NWS Taguac at 0946Z. The minimum recorded surface pressure was 931.7 mb at NAS Brewer Field, some 5 nm northeast of the center. The lowest pressure of approximately 930 mb (indicated by aircraft and land stations) supports estimated peak sustained winds of 120 kt with gusts of 145 kt. Pamela's winds gusted as much as 80 kt between peak and lull in a matter of minutes, resulting in extremely large pressure differences (60-70 lbs per square foot) on windward and leeward sides. Few unreinforced structures were able to withstand the intermittent pressure and wrenching effects. NWS Taguac recorded 33 inches of rain during Pamela's passage, with 27 inches falling in a 24-hour period.

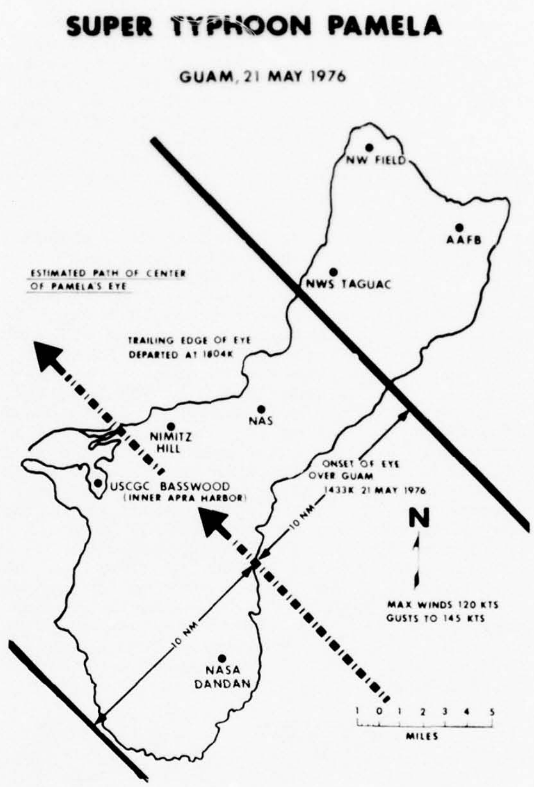


FIGURE 4-9. *Estimated path of the center of Pamela's eye as it crossed Guam from 0433Z to 0804Z, 21 May 1976.*

Although the winds of Pamela were 25 kt weaker than those of Typhoon Karen which flattened the island in November 1962, the slow 7 kt movement rendered Pamela more destructive (Fig. 4-10 and back cover). The 226 square mile island was buffeted by winds in excess of 100 kt for 6 hours, by winds of typhoon force for 18 hours and by winds exceeding 50 kt for 30 hours. The last warning on Pamela by JTWC was issued at 2320Z on the 20th. The alternate JTWC at Yokota AB, Japan assumed all warning responsibilities for Pamela and Olga during the next 5 days.

All Naval and Air Force units had been given adequate warning and had evacuated most

of their ships and aircraft. Despite extensive preparations damage to civilian and military facilities was severe, exceeding $500 million (Fig. 4-11, Fig. 4-12 and Fig. 4-13). Ten small ships and tugs which had sought refuge in Apra Harbor, were either sunk or ran aground, and numerous other small craft were sunk or damaged (Fig. 4-14). One ship, the U. S. Coast Guard Cutter Basswood, courageously rode out the storm anchored in Apra Harbor where it recorded a peak gust of 120 kt and a minimum sea level pressure of 933.1 mb.

Miraculously, only one death occurred on Guam due to Pamela's passage. This low loss of life was attributed to the timely and accurate forecasts issued on the storm. A comprehensive account of lessons learned from Pamela is given in the Super Typhoon Pamela After-Action Report, prepared by CINCPAC REP GUAM/TTPI in August 1976.

FIGURE 4-11. *Destruction was widespread in Guam's civilian community. Concrete stuctures fared well, but wooden houses, power lines and the telephone system were all severely damaged. (Official U. S. Navy photograph)*

FIGURE 4-10. *The twisted steel skeleton of a once substantial warehouse attests to the destructive force of Pamela. (Official U. S. Navy photograph)*

FIGURE 4-12. *The long line at Andersen AFB, Guam was representative of those throughout the island as the refugees of Pamela gathered for food, water and other supplies. (Official U. S. Navy photograph)*

FIGURE 4-13. *Super Typhoon Pamela inflicted heavy damage to military facilities on Guam. This is Andersen AFB housing. (Official U. S. Navy photograph)*

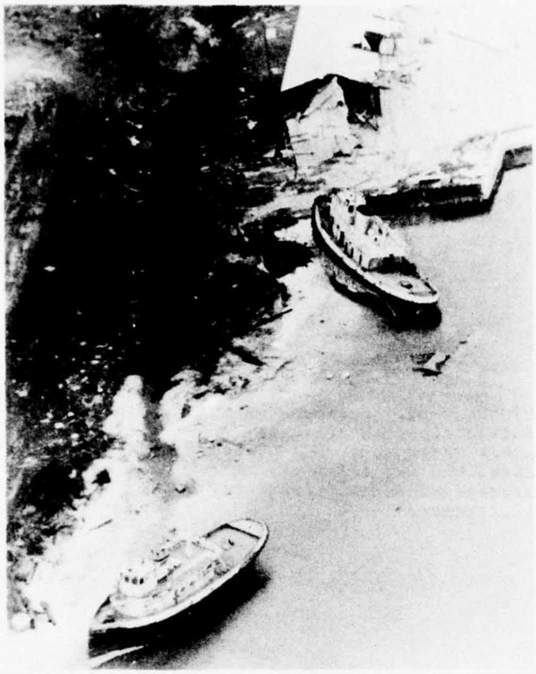


FIGURE 4-14. *Two grounded tugs at U. S. Naval Station, Guam. Powerful wind and wave action produced by Typhoon Pamela affected even the inner Apra Harbor. (Official U. S. Navy photograph)*

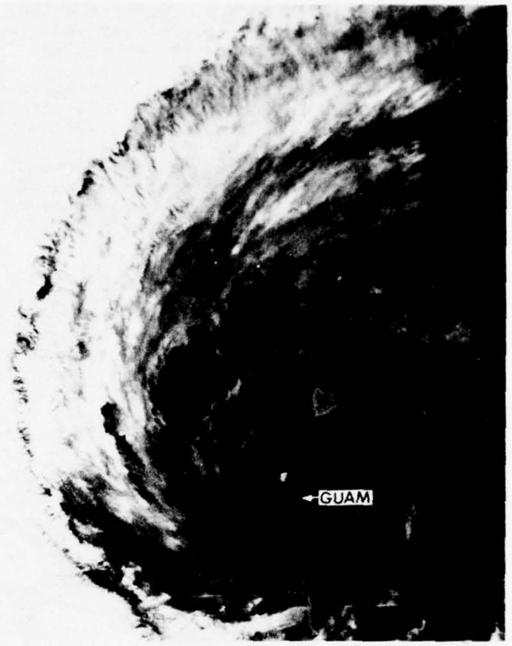


FIGURE 4-15. *Infrared photograph of Typhoon Pamela at 120 kt 30 nm northwest of Guam, 21 May 1976, 1018Z. (DMSP imagery)*

After devastating Guam, Pamela continued to maintain its 120 kt intensity for an additional 36 hours, moving northwestward at an average speed of 10 kt (Fig. 4-15). Saipan (91232) experienced gusts of 55 kt and received 10 inches of rain as the storm passed 120 nm west of the island. As Pamela continued to threaten the northern Mariana Islands, mop-up operations were in full swing on Guam (Fig. 4-16 and Fig. 4-17). Although the civilian and military factions were well-organized and worked closely together, recovery efforts took months.

On the morning of the 23rd Pamela, still packing winds of 115 kt, slowed to 8 kt, and by that evening had passed through a weakness in the mid-tropospheric subtropical ridge, recurving to the northeast. At 2000Z on the 24th, Pamela passed 15 nm to the east of Iwo Jima (47981) blanketing the island with 75 kt winds (Fig. 4-18). By 1800Z on the 25th the system had weakened into a tropical storm. The cooler sea surface temperatures and tremendous vertical shear rapidly stripped the storm of its tropical characteristics, and by the afternoon of the 26th Pamela had become extratropical.

Pamela's 15 day trek took it a distance of 2570 nm during which a total of 52 warnings were issued, 40 of them as a typhoon.

FIGURE 4-16. *An Air Force crew removes one of numerous trees uprooted during Pamela's rampage. This was typical of island-wide clean-up operations performed by military and civilian personnel. (Official U. S. Navy photograph)*

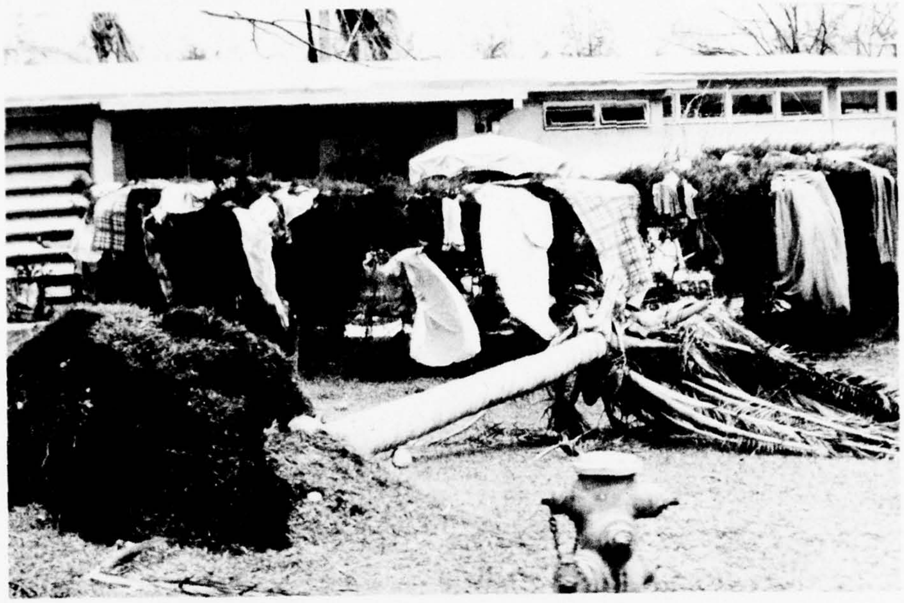


FIGURE 4-17. *Few, if any, establishments on Guam escaped water damage from Pamela's driving rains. Massive destruction to power transmission facilities rendered drying-out a slow process. (Official U. S. Navy photograph)*

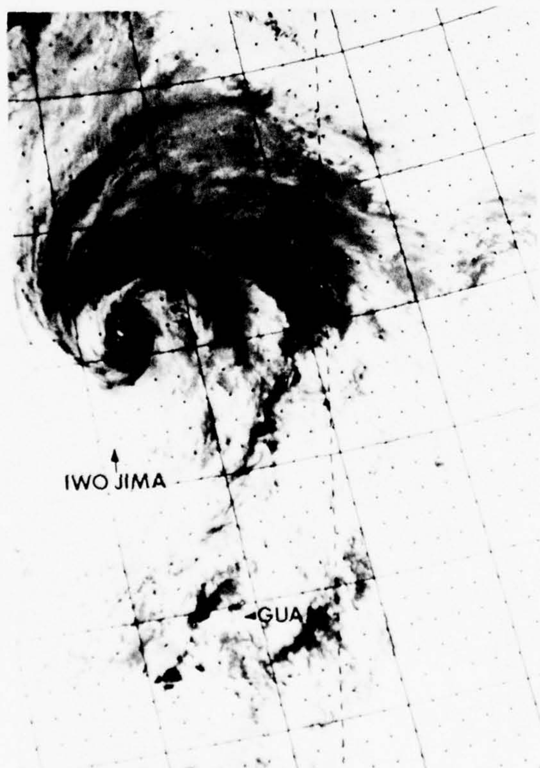
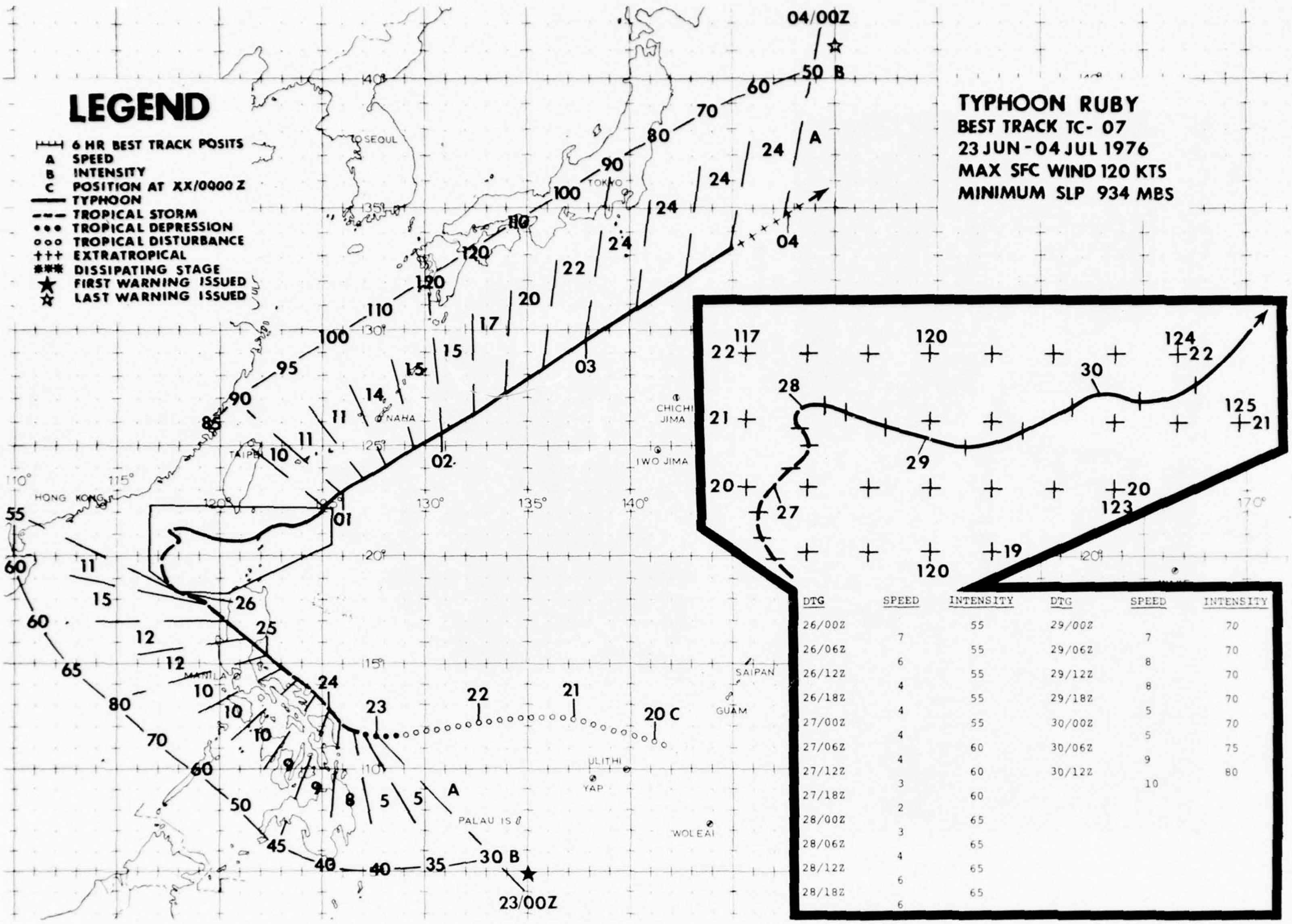


FIGURE 4-18. *Infrared image of Typhoon Pamela at 65 kt 95 nm northeast of Iwo Jima, 25 May 1976, 0931Z. (DMSP imagery)*



DTG	SPEED	INTENSITY	DTG	SPEED	INTENSITY
26/00Z	7	55	29/00Z	7	70
26/06Z	6	55	29/06Z	8	70
26/12Z	4	55	29/12Z	8	70
26/18Z	4	55	29/18Z	5	70
27/00Z	4	55	30/00Z	5	70
27/06Z	4	60	30/06Z	9	75
27/12Z	3	60	30/12Z	10	80
27/18Z	2	60			
28/00Z	3	65			
28/06Z	4	65			
28/12Z	6	65			
28/18Z	6	65			

The month of June was characterized by a persistent monsoon trough which was the breeding ground for numerous tropical disturbances. Ruby, the 5th typhoon of the season, was detected in this trough as an area of heavy thunderstorm activity located some 250 nm southwest of Guam. This region of convective activity was monitored for 3 days before undergoing significant intensification.

On the morning of the 23rd satellite data indicated that the disturbance had organized into a tropical depression located some 450 nm southeast of Manila, moving westward. Based on this information the first warning was issued on the 23rd at 0000Z. Reconnaissance aircraft at 1205Z indicated that TD 07 had attained tropical storm intensity; flight level winds of 70 kt and a central pressure of 987 mb were reported. Radar reports from Catanduanes Island (98446) further indicated that Tropical Storm Ruby was moving northwestward in response to weak steering south of the mid-tropospheric subtropical ridge.

At 2100Z on 23rd reconnaissance aircraft reported further development; Ruby had intensified, with an eye and surface winds in excess of 70 kt. This rapid intensification was in response to the westward movement of an intense cold-core low in the Tropical Upper Tropospheric Trough (TUTT) which increased the upper level outflow and destabilized the tropospheric column, enhancing convection.

On the afternoon of the 25th Ruby, still tracking northwestward, began its passage over central Luzon crossing the eastern coast 10 nm south of Cape Ildefonso with winds of 80 kt. Official reports of damage resulting from Ruby's passage were unavailable. However, Pacific Stars and Stripes did report in their July 4th issue that 16 persons in the province of Benguet were killed as a result of mudslides triggered by heavy rains.

Passage over the Philippines weakened Ruby into a tropical storm. Further weakening was experienced in the South China Sea when the storm's vertical organization became sheared by strong upper tropospheric northeasterly flow emanating from the massive Asian upper level anticyclone.

On the morning of the 26th, Ruby began to move northward, and passed 35 nm east of Pratas Island on the 27th at 0600Z. Thirty-five knot winds and a sea level pressure of 985 mb were observed. By the morning of the 28th satellite data indicated that the vertical organization had become realigned and that Ruby had reintensified (Fig. 4-19). This had resulted from the westward regression of an upper tropospheric short wave trough to a position slightly northwest of Ruby's anticyclone. This blocked the earlier upper level shearing flow and enhanced outflow. Shortly after realignment a slow, eastward progression of the upper tropospheric trough steered Ruby to the east toward Typhoon Sally. It appears that any Fujiwara interaction between Ruby and Sally was either very small or nonexistent.

As Ruby traveled eastward through the Bashi Channel, radar reports from Kao-hsiung indicated eastward movement and intensification (Fig. 4-20). Reconnaissance aircraft at 1600Z on July 1st recorded the lowest pressure, 934 mb, and indicated that Typhoon Ruby was moving toward the northeast.

Ruby maintained typhoon intensity until the night of the 3rd when it again moved into a hostile shearing environment. Meteorological satellite data at 2312Z on the 3rd indicated that Ruby had finally become extratropical after its 10 day trek.

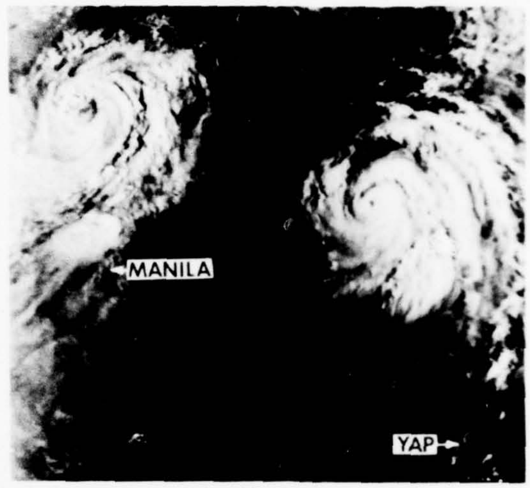


FIGURE 4-19. *Ruby (left) near typhoon intensity 430 nm north-northwest of Manila, 27 June 1976, 2223Z. Typhoon Sally is some 800 nm to the east-southeast. (DMSP imagery)*

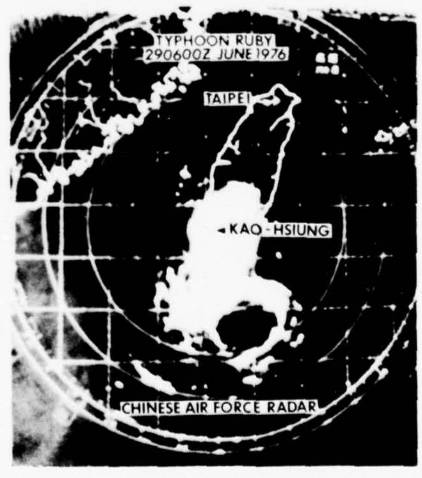
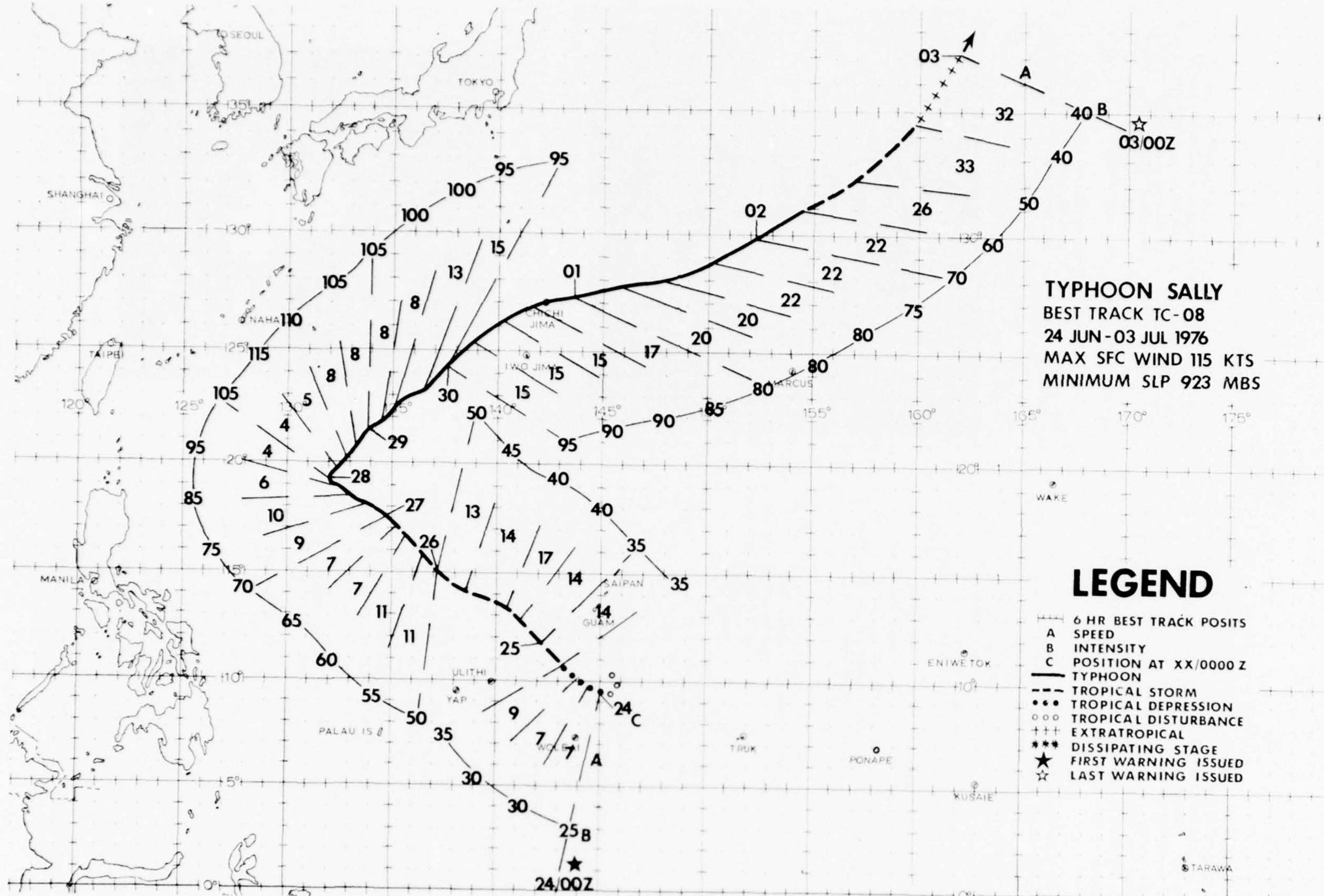


FIGURE 4-20. *Radar presentation of Typhoon Ruby at 70 kt intensity 125 nm south-southeast of Kao-hsiung, Taiwan, 29 June 1976, 0600Z. (Picture courtesy of Central Weather Bureau, Taipei, Taiwan, Republic of China.)*


TYPHOON SALLY
BEST TRACK TC-08
24 JUN-03 JUL 1976
MAX SFC WIND 115 KTS
MINIMUM SLP 923 MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
24/00Z
03/00Z
SEOUL
TOKYO
SHANGHAI
NAHA
TAIPEI
MANILA
CHICHI JIMA
IWO JIMA
MARCUS
WAKE
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
TRUK
PONAPE
KUSAIE
ENIWETOK
TARAWA

SALLY

Sally, the 6th typhoon of the season, was first detected on the evening of June 23rd as a weak disturbance in the near-equatorial trough 210 nm south of Guam. During the next 36 hours the disturbance remained quasi-stationary as it slowly intensified. The first warning was issued at 0000Z on the 24th as the system intensified to 30 kt and began moving northwestward at 7 kt. Intensification was slow during the subsequent 30 hours as southeastward pressure from the Tropical Upper Tropospheric Trough (TUTT) to the northwest inhibited establishment of an efficient outflow channel to the north. By the evening of the 26th the TUTT had moved northward and Sally began more rapid intensification, attaining typhoon intensity at 1800Z on the 26th and a maximum intensity of 115 kt 36 hours later (Fig. 4-21 and Fig. 4-19: Typhoon Ruby). Reconnaissance aircraft reported a 40 mb drop in pressure (964 to 924 mb) from 0716Z on the 27th to 0230Z on the 28th, an average fall of 2 mb per hour.

By 1200Z on the 27th, Sally had slowed to 6 kt and had taken a more northward track. During the following 12 hours the typhoon moved slowly north, then north-northeast as Ruby, some 820 nm to the west, attained typhoon force and began moving toward the east. By 1200Z on the 29th the distance between the two typhoons had closed to 790 nm and conditions for a Fujiwara interaction appeared favorable. However, between 1200Z on the 28th and 0000Z on the 29th, the axis of the mid-tropospheric subtropical ridge shifted some 300 nm to the south as westerly winds rapidly expanded equatorward. This unusually rapid shift of westerlies allowed a mid-tropospheric trough which had been far north of Sally to also move equatorward. Sally responded by recurving to the northeast and by 1200Z on the 29th had accelerated to 13 kt. At 0000Z on the 30th a ship, EWWY, reported sustained 50 kt winds 120 nm northwest of the storm which still possessed 95 kt winds (Fig. 4-22).

At 1800Z on the 30th, Chichi Jima (40 nm northeast of Sally) reported southeasterly winds of 30 kt and a sea level pressure of 980.5 mb. Twelve hours later the rapidly moving storm was 180 nm east-northeast of the island. During the 2nd of July the system began more rapid weakening and became extratropical on the 3rd while traveling at more than 30 kt and still possessing surface winds of 40 kt.

FIGURE 4-21. *Typhoon Sally at point of recurvature with 100 kt intensity 540 nm southeast of Okinawa, 27 June 1976, 2223Z. (DMSP imagery)*

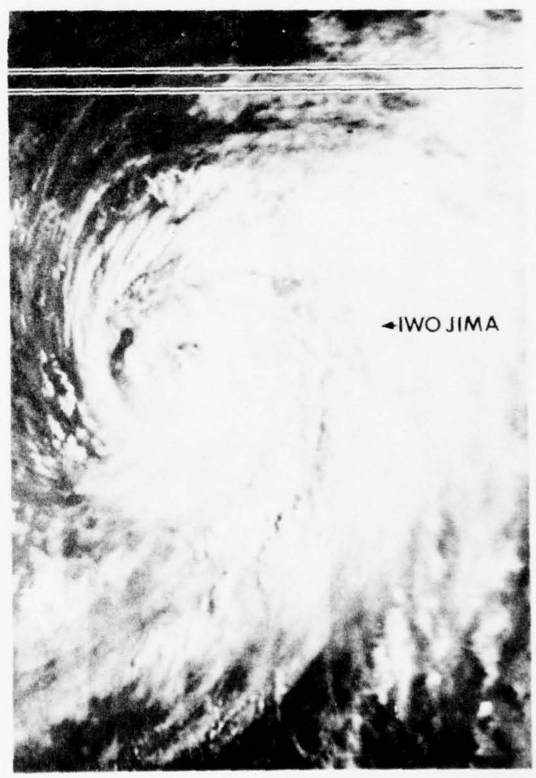
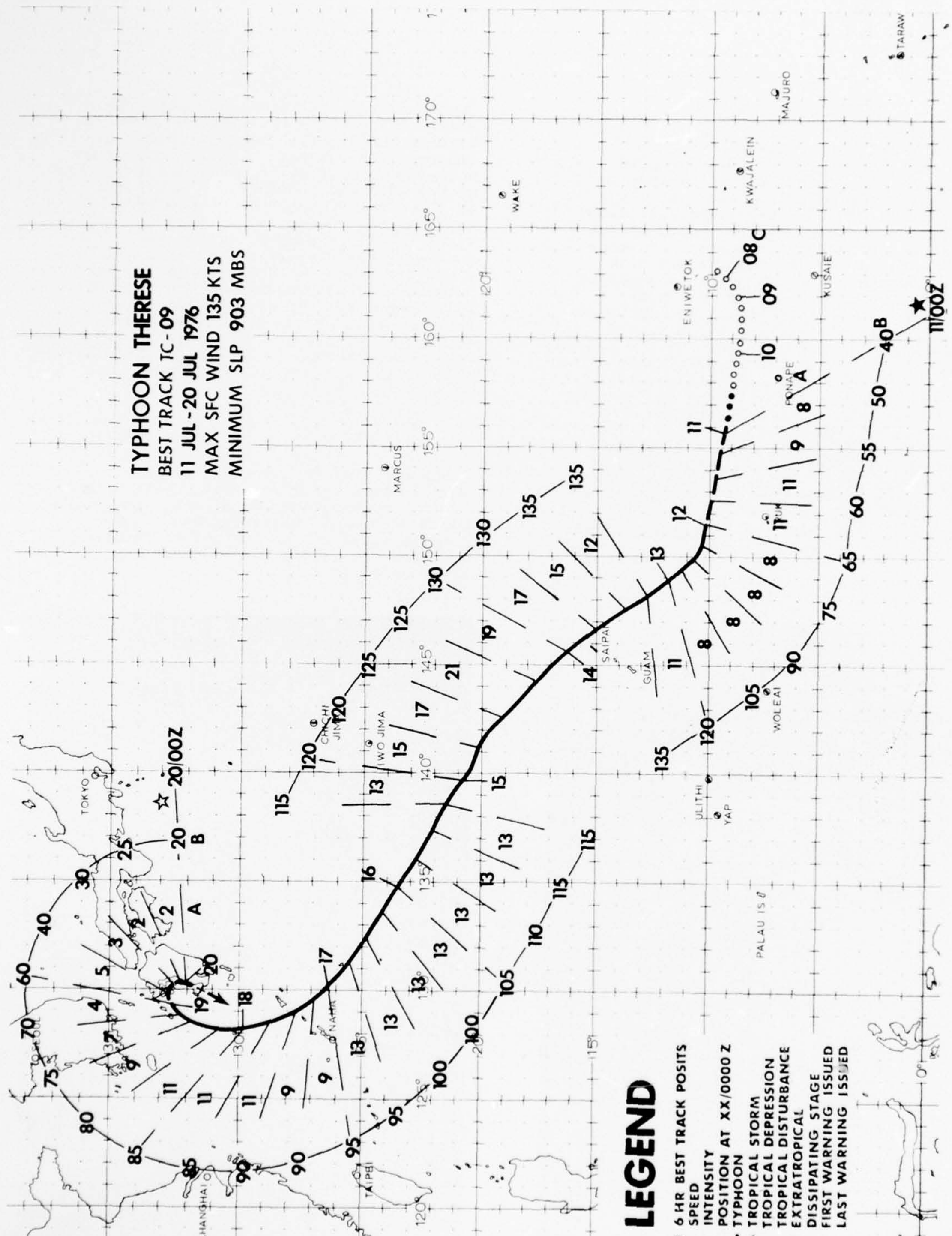


FIGURE 4-22. *Typhoon Sally at 95 kt 235 nm west-southwest of Iwo Jima, 29 June 1976, 2159Z. (DMSP imagery)*


TYPHOON THERESE
BEST TRACK TC-09
11 JUL-20 JUL 1976
MAX SFC WIND 135 KTS
MINIMUM SLP 903 MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
20/00Z
11/00Z
TOKYO
SHANGHAI
NAHA
TAIPEI
CHICHI JIMA
IWO JIMA
MARCUS
WAKE
SAIPAN
GUAM
ULITHI
YAP
WOLEAI
PALAU IS
PONAPE
KUSAIE
ENIWETOK
KWAJALEIN
MAJURO
TARAWA

THERESE

Near the end of the first week in July a tropical disturbance was detected by satellite near 9N-160E, moving slowly westward. At 2322Z on the 9th a formation alert was issued when satellite data indicated that the system was beginning to organize. During the next 24 hours the disturbance intensified rapidly, and aircraft observed winds of tropical storm intensity. At 0000Z on the 11th the first warning was issued on Tropical Storm Therese with winds of 40 kt near the center. For the next 24 hours Therese continued to intensify while accelerating slowly on a west-northwest course south of a well established subtropical ridge. By 0000Z on the 12th Therese had reached typhoon intensity. As the subtropical ridge to the north of the storm shifted northward, the typhoon reacted by slowing and moving toward the northwest. Near 1200Z on the 12th explosive deepening began to occur in response to enhanced outflow resulting from a cold-core, upper tropospheric low northwest of Therese. Reconnaissance aircraft indicated that from 0805Z on the 12th until 0537Z on the 13th, the storm's central pressure plummeted 66 mb, a rate of 3.1 mb per hour (Fig. 4-23). Therese had become the 2nd super typhoon of the season, attaining a minimum surface pressure of 903 mb and maximum winds of 135 kt at 0600Z on the 13th. Therese maintained super typhoon intensity for the next 18 hours, and at 2100Z on the 13th passed 30 nm northeast of Saipan with 130 kt winds near the center. Saipan sustained only minor damage with observed winds estimated at 75 to 100 kt.

Typhoon Therese began to accelerate along the southwestern periphery of the subtropical ridge heading toward a weakness near 130E. The system continued to weaken slowly as it tracked farther north, still maintaining good outflow in all quadrants. At 1800Z on the 16th Therese passed 25 nm southwest of Minamidaito Jima where maximum sustained winds of 50 kt and a minimum sea level pressure of 966.9 mb were recorded. By the morning of the 17th Therese had slowed to 9 kt, and began to recurve toward the north in response to a long wave trough at the 200 mb level. At 0900Z the typhoon, still possessing 90 kt winds, passed 60 nm northeast of Okinawa where 41 kt gusts were recorded at Kadena AB. Directly ahead of the storm, Tokuno-Shima was reporting 50 kt winds. At 1200Z the island experienced eye passage with a recorded central pressure of 958 mb (Fig. 4-24).

For the next 24 hours Therese continued moving northward along the western edge of the subtropical ridge maintaining typhoon intensity. At 1200Z on the 18th Meshima (47842) reported sustained winds of 65 kt and minimum sea level pressure of 971.2 mb. Shortly thereafter Therese passed 10 nm east of the island as it turned to the northeast toward the west coast of Kyushu. By 1200Z on the 19th Therese had made landfall on the coast of Kyushu with 40 kt winds. After crossing the coast, the storm continued to dissipate over the mountainous terrain. The final warning was issued at 0000Z on the 20th as Therese became quasi-stationary over southern Japan.

Prior to dissipation, Therese brought nearly 20 inches of rain to the island of Kyushu. The storm flooded more than 1000 homes and sank 12 ships. During the onslaught, 3 persons were killed, more than 1300 were rendered homeless, and damage to crops was estimated in the millions of dollars.

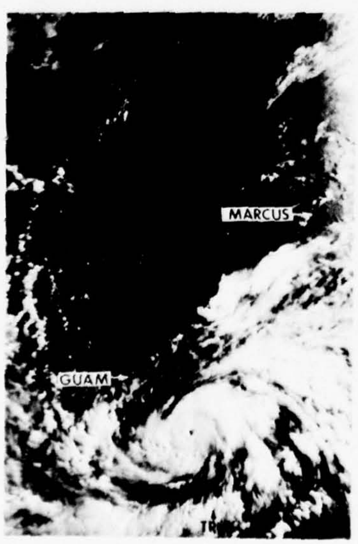
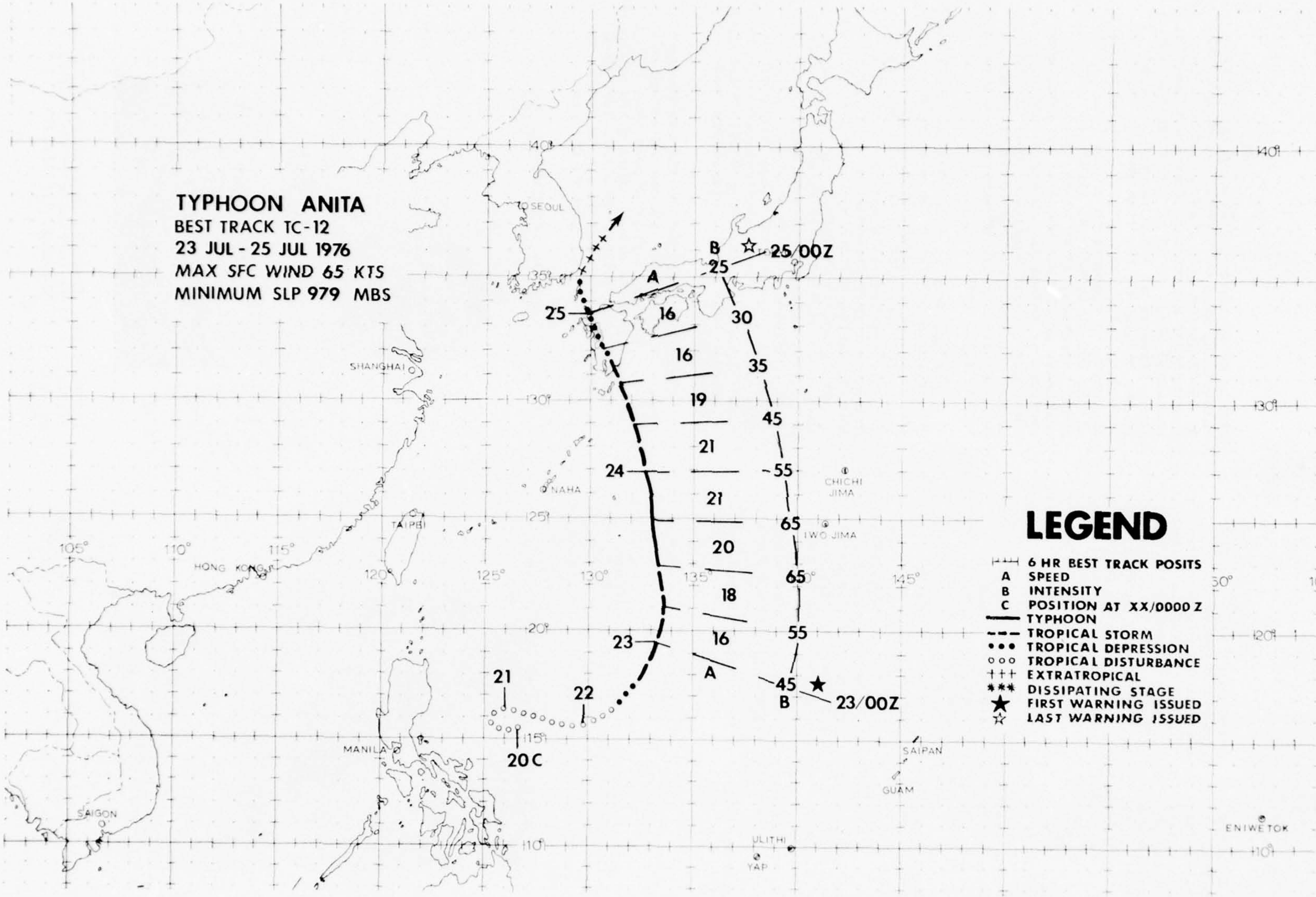


FIGURE 4-23. *Typhoon Therese near 115 kt undergoing explosive deepening 260 nm southeast of Guam, 12 July 1976, 2104Z. (DMSP imagery)*

FIGURE 4-24. *Infrared photograph of Typhoon Therese at 90 kt intensity 90 nm northeast of Kadena AB, Okinawa, 17 July 1976, 1042Z. (DMSP imagery)*


TYPHOON ANITA
BEST TRACK TC-12
23 JUL - 25 JUL 1976
MAX SFC WIND 65 KTS
MINIMUM SLP 979 MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
25/00Z
23/00Z
20C
SEOUL
SHANGHAI
NAHA
TAIPEI
HONG KONG
MANILA
SAIGON
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
ENIWETOK

Anita had its inception in mid-July within the monsoon trough which was enhanced by cross equatorial flow at low levels. Three distinct surface circulation centers were evident on the 20th: one in the South China Sea which developed into Tropical Storm Violet; and two in the Philippine Sea which eventually became Tropical Storm Wilda and Typhoon Anita.

As early as the 18th, the weak circulation, which eventually developed into Anita, was tracked by satellite. Initially the disturbance moved slowly westward along the southern edge of the mid-tropospheric subtropical ridge, but by the 20th a break had developed in the ridge near 135E and extended northward to Japan. At the same time, a high pressure center was building northwestward from its center location over Mindanao, forcing a wedge between the disturbance located in the South China Sea and those in the Philippine Sea. In response to this ridging, the disturbance which would become Anita reversed course on the 21st and began to head eastward.

The synoptic pattern at the 200 mb level from the 18th through the 20th found the Tropical Upper Tropospheric Trough (TUTT) positioned just north of the disturbances in the Philippine Sea. The flow around the trough initially suppressed the upper level outflow from the disturbances, however, by the 21st the trough began to recede northward, relieving the pressure. Midway through the 21st, a cyclonic cell within the TUTT moved into a position favorable to enhance the outflow of the disturbance which became Wilda, and duplicated this mechanism 24 hours later for Anita. On the 22nd, Wilda and Anita were developing simultaneously. They attained tropical depression characteristics at 0600Z and 1200Z, respectively. By 1200Z Wilda had accelerated northward along the western side of the subtropical ridge, allowing Anita to develop independently at an accelerated pace. By 1800Z Anita had attained tropical storm intensity, and began to move through the weakness left by Wilda.

As Anita continued to intensify, the size of the storm remained relatively small. Aircraft reconnaissance on the 23rd found only a narrow band of strong winds near the storm center. As Anita progressed northward through the weakness, it continued to intensify, reaching a peak of 65 kt and a minimum sea level pressure near 979 mb at 1200Z on the 23rd. The NOAA-4 satellite picture at 1207Z on the 23rd (Fig. 4-25) caught Anita at its peak intensity with a ragged eye discernible between two interlocking convective bands.

About the time Anita attained typhoon intensity, it also began to accelerate northward on a path similar to that taken by Wilda. With this acceleration, Anita was again thrust under the influence of unidirectional shearing. This suppressed Anita's outflow and contributed to loss of vertical stacking. The shear persisted for the duration of Anita's life, forcing the system to weaken almost as fast as it had developed. Anita's typhoon intensity lasted only 12 hours. Satellite data at 2214Z on the 23rd indicated that the storm had lost most of its hard core convection (Fig. 4-26). Thus, Anita was downgraded to a tropical storm at 0000Z on the 24th. As the system sped northward at 20 kt, it continued to weaken crossing western Kyushu late on the 24th with minimal tropical storm intensity. On the 25th, the remains of Anita entered the Sea of Japan and became extratropical at 0600Z while moving northward at 14 kt.

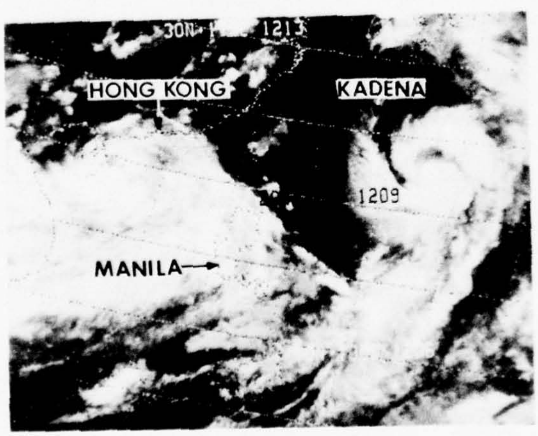


FIGURE 4-25. *Inverted infrared photograph of Typhoon Anita (right) at peak intensity 360 nm southeast of Kadena AB, Okinawa. At left Tropical Storm Violet approaches the China coast, 23 July 1976, 1209Z. (NOAA-4 imagery)*

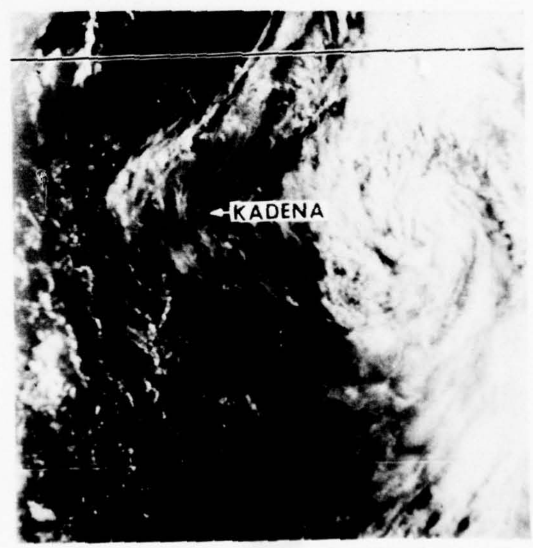
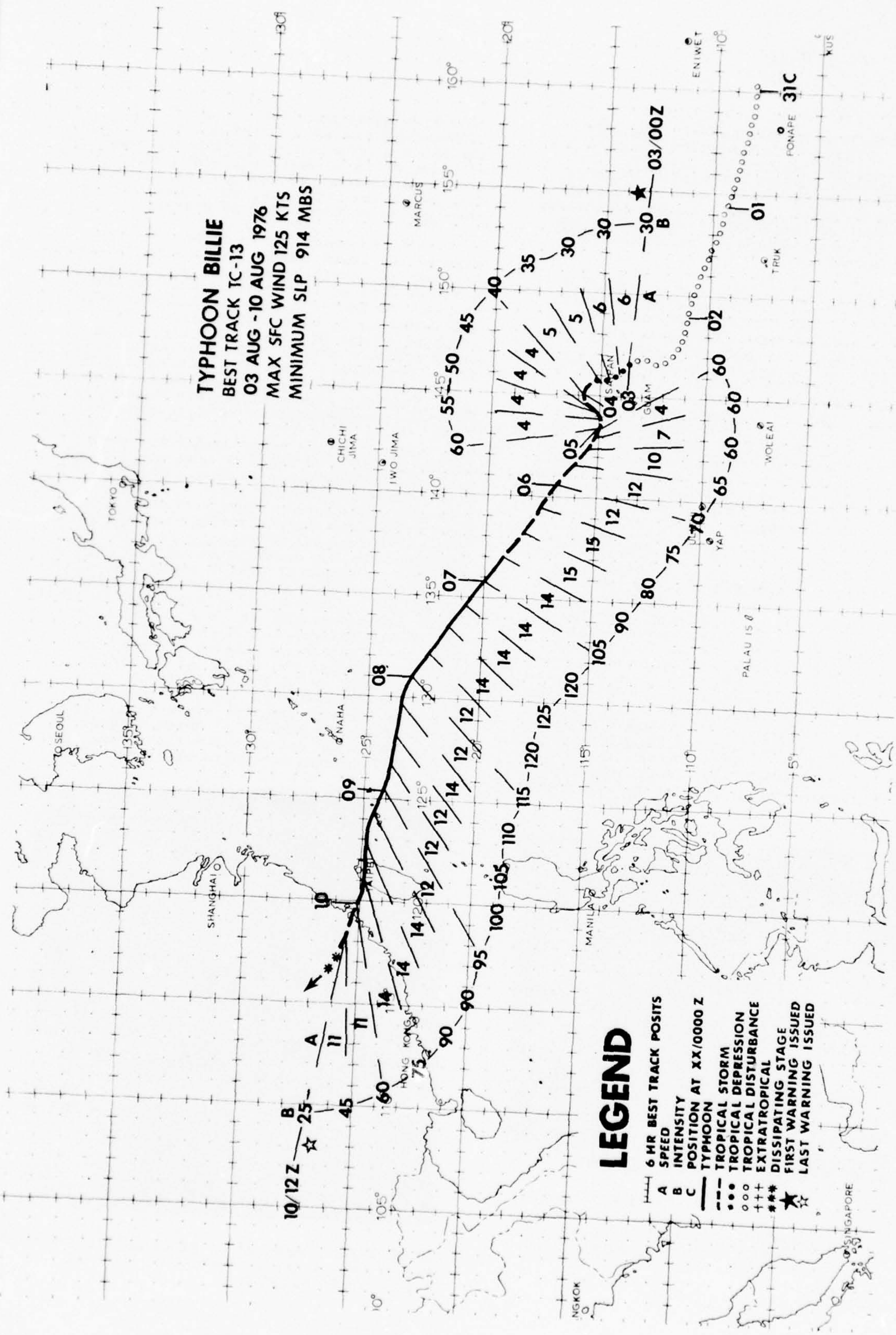


FIGURE 4-26. *Anita at 60 kt intensity 270 nm east of Kadena AB, Okinawa, 23 July 1976, 2214Z. (DMSP imagery)*


TYPHOON BILLIE
BEST TRACK TC-13
03 AUG - 10 AUG 1976
MAX SFC WIND 125 KTS
MINIMUM SLP 914 MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
10/12 Z
03/00Z
31C
TOKYO
SEOUL
SHANGHAI
NAHA
HONG KONG
MANILA
SINGAPORE
CHICHI JIMA
IWO JIMA
MARCUS
GUAM
SAIPAN
YAP
WOLEAI
TRUK
PONAPE
ENIWETOK
PALAU IS

Billie, the 9th typhoon of the season, was first observed on the morning of July 31st as a disturbance in the near equatorial trough approximately 180 nm northeast of Ponape. During the subsequent two days the system demonstrated little intensification as it moved toward the west-northwest at 14 kt. Throughout this period poor vertical stacking and unidirectional flow through the system in the 300 mb to 200 mb region hindered development.

On the evening of 2 August, meteorological satellite data indicated that the disturbance had turned toward the north and was becoming better organized. By the morning of the 3rd, the convective system had consolidated and had acquired strong banding from the northeast and southwest (Fig. 4-27). At 0000Z on the 3rd the disturbance was placed into warning status as TD 13 centered about 100 nm east of Guam. Ship reports at 0000Z indicated 30 knot surface winds and aircraft at 0052Z reported 40 kt flight level (700 mb) winds from the south, 20 nm east of the depression center.

By late morning on the 3rd, the northward movement of the tropical system had positioned it near the southern periphery of the mid-tropospheric subtropical ridge. In response, the tropical depression turned sharply toward the northwest in the direction of Saipan. Between 1700Z and 1800Z on the 3rd, TD 13 passed over Saipan where the 1800Z synoptic reports indicated southwesterly winds at 15 kt, a sea level pressure of 999.8 mb and a 6-hour rainfall of 3.86 inches. At 1800Z the depression was designated Tropical Storm Billie.

By 0000Z on the 4th the storm had intensified to 40 kt, and the northwestward track changed to a 4 kt southwestward track. Since the 3rd an intense low cell in the Tropical Upper Tropospheric Trough (TUTT) was slowly propagating southwestward toward the storm. By the 4th this low cell and its associated trough was applying considerable southward pressure on the anticyclone above Billie. By this time the upper, middle and lower components of the storm were strongly coupled and the entire storm moved southwestward with the anticyclone. Billie continued to slowly intensify as outflow in all but the northeast quadrant remained good.

During this period of erratic movement it appeared that Billie would be a threat to Guam. However, by the afternoon of the 5th the TUTT began to rapidly recede to the northwest. This affected the storm in two ways: (1) It relieved the southwestward pressure allowing the storm to acquire a westward and ultimately a northwestward track; and (2) It allowed the low cell within the TUTT to move north of Billie, restricting outflow and temporarily slowing the intensification rate. By the 6th, the upper low had moved considerably westward, eliminating its restricting influence on the tropical cyclone. Billie reacted by accelerating on a northwestward track and attaining typhoon intensity by 1800Z on the 5th (Fig. 4-28).

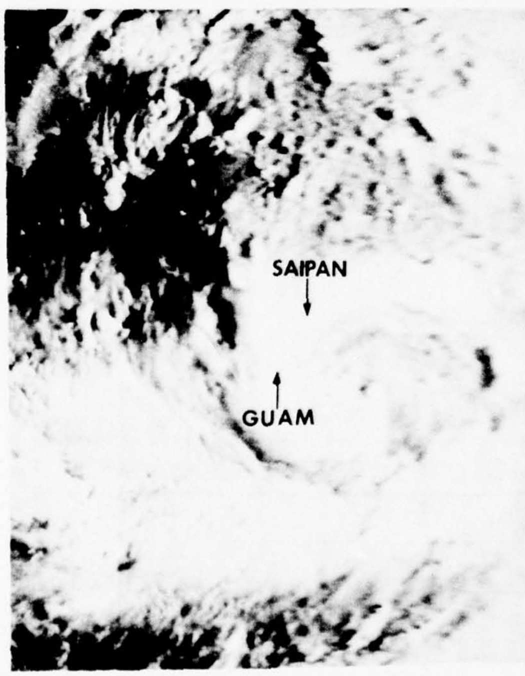


FIGURE 4-27. *Billie during its early development at 30 kt intensity 100 nm east of Guam, 2 August 1976, 2155Z.*

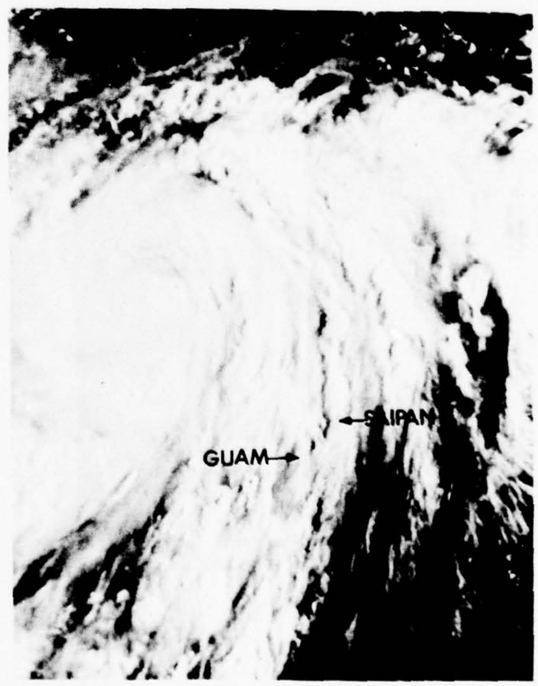


FIGURE 4-28. *Billie at minimal typhoon intensity 275 nm northwest of Guam, 5 August 1976, 2118Z. (DMSP imagery)*

During the subsequent 2 days Typhoon Billie continued its trek toward the northwest at 12 to 15 kt. Throughout this period outflow above the typhoon was unobstructed, allowing the system to intensify rapidly. From the night of the 6th until the morning of the 7th Billie underwent explosive deepening as an upper level trough west of the cyclone enhanced outflow in the northern semicircle and an unrestricted channel to the Southern Hemisphere subtropical jet stream enhanced outflow in the south semicircle. Reconnaissance aircraft at 1448Z on the 6th and at 0340Z on the 7th indicated that during this 13 hour period the eye temperature at 700 mb rose from 17°C to 26°C, and that the central pressure had fallen 46 mb, a rate more than 3.5 mb per hour. The 914 mb reported at 0350Z on the 7th was the minimum pressure attained by Billie. During this reconnaissance flight maximum surface winds were estimated to be 120 kt. At 0800Z on the 7th a ship, JPLY, reported southwesterly winds of 50 kt and a minimum sea level pressure 992.3 mb while located 70 nm south-southeast of the typhoon (Fig. 4-29). At 1200Z on the 7th Typhoon Billie reached its maximum intensity of 125 kt.

By the morning of the 8th the upper level trough, which had been located to the west of Billie, had been forced east of the typhoon by the rapid eastward expansion of a massive Asian upper level anticyclone. This upper level synoptic pattern exposed the region north of Billie to strong northeasterly flow which drastically reduced the outflow to the north and dictated a more westward movement for the tropical cyclone. This synoptic pattern persisted throughout the remainder of the storm's life, causing it to weaken and to move in a westward direction at 11 to 14 kt until it dissipated over mainland China.

By 0000Z on the 9th Bille had moved into the southern Ryukyu Islands. Fig. 4-30 illustrates surface observations from 0000Z through 1000Z on the 9th at the island stations of Miyako Jima (47927) and Ishigaki Shima (47918). Miyako Jima reported its lowest sea level pressure 964.4 mb at 0400Z while experiencing 44 kt sustained winds. Two hours later Ishigaki Jima reported a pressure of 952.0 mb and northwesterly winds of 45 kt. At about 0700Z Typhoon Billie passed over the northern tip of Ishigaki Jima with maximum winds estimated at 95 kt,

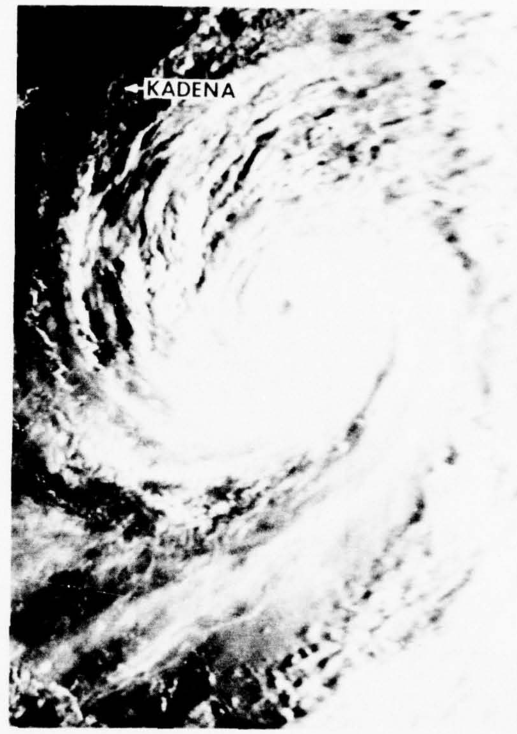


FIGURE 4-29. *Typhoon Billie at 115 kt intensity 300 nm southeast of Kadena AB, Okinawa, 7 August 1976, 2236Z. (DMSP imagery)*

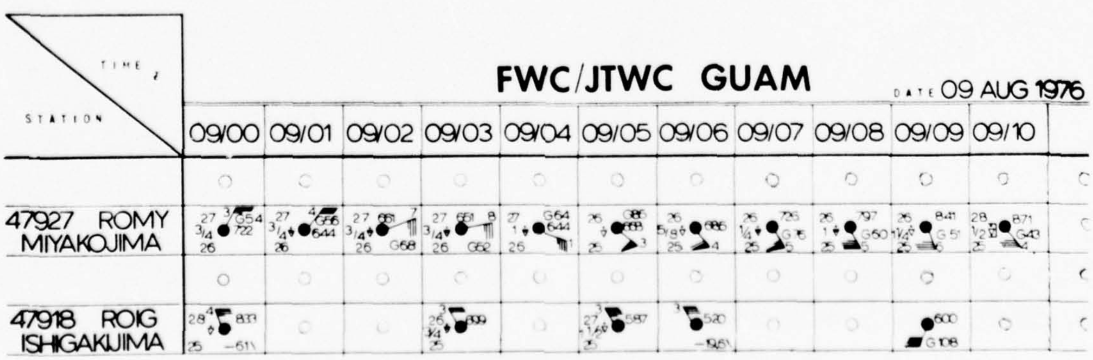


FIGURE 4-30. *Available synoptic surface observations at Miyako Jima and at Ishigaki Jima during the passage of Typhoon Billie.*

and two hours later the island reported southwesterly winds of 91 kt with gust to 108 kt (Fig. 4-31). Newspaper reports stated that "huge waves south of Japan drowned 41 fisherman and swimmers along Japan's Pacific coast."

After its destructive whirl through the Ryukyus, Billie headed for Taipei traveling westward at 14 kt (Fig. 4-32). At 1200Z on the 9th, Penkiayu (46695) reported north-easterly winds of 77 kt. Taipei International Airport experienced 30 kt sustained winds with gusts to 65 kt, and a sea level pressure of 957.3 mb was observed at 1600Z; about one hour later the eye passed just south of Taipei.

Typhoon Billie exited Taiwan near Hsin-chu and moved toward the People's Republic of China on a west-northwestward track. By the morning of the 10th Billie had weakened into a tropical storm and slowed to 11 kt. At 0000Z on the 10th P'ing-t'an (58944) reported 60 kt winds from the north-northeast and a sea level pressure of 981.2 mb. About 0300Z Billie went ashore 25 nm southeast of P'ing-t'an. Within hours the storm had dissipated over the rugged terrain of eastern China.

Billie's passage over Taiwan was highly destructive (Fig. 4-33). Reports indicated 4 dead, 24 injured and 8 missing. Nearly 1000 homes were destroyed in the onslaught. Three ships were sunk and 7 others were severely damaged. Damage to power transmission facilities was estimated at $2,630,000.

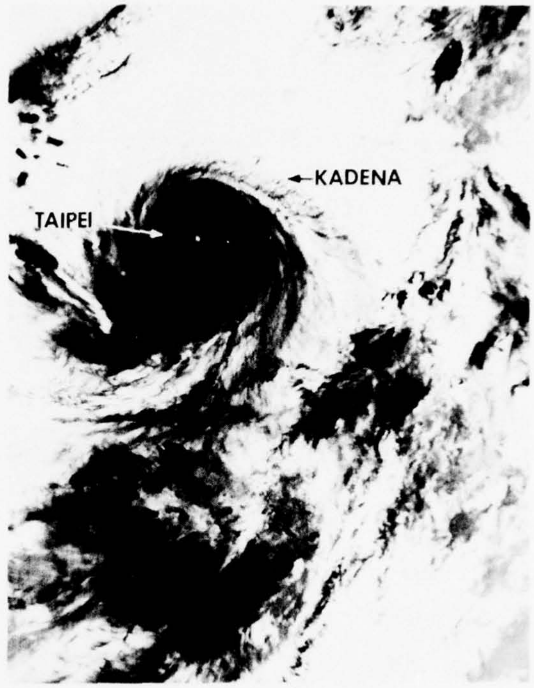


FIGURE 4-32. *Infrared photograph of Typhoon Billie exiting the southern Ryukyu Islands with 90 kt intensity, 95 nm east of Taipei, 9 August 1976, 1109Z. (DMSP imagery)*

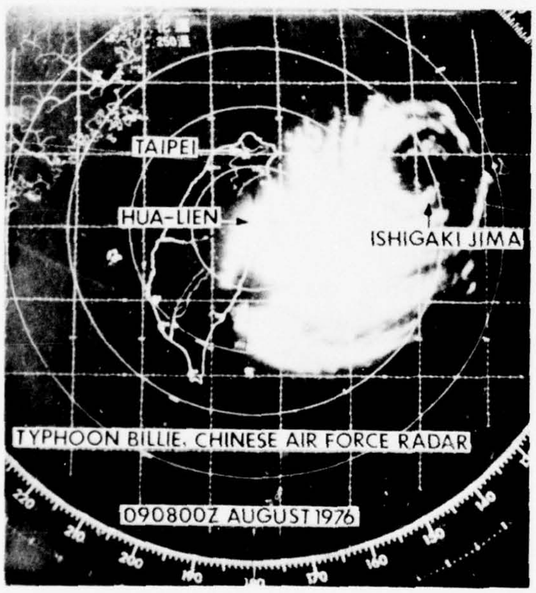
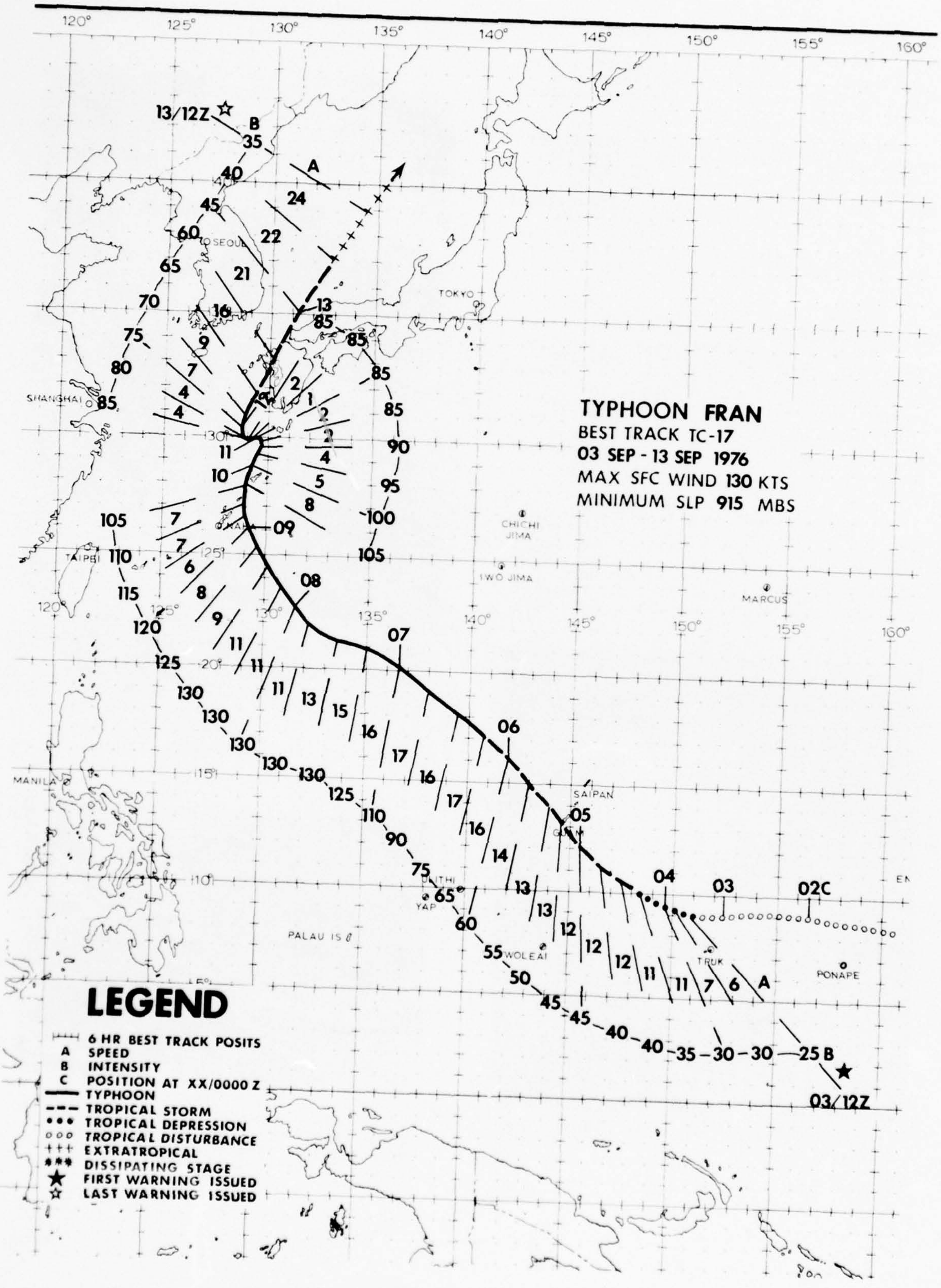


FIGURE 4-31. *Radar presentation of Typhoon Billie as it pounds Ishigaki Jima with 90 kt winds, 150 nm east of Taipei, 9 August 1976, 0800Z. (Photograph courtesy of the Central Weather Bureau, Taipei, Taiwan, Republic of China.)*

FIGURE 4-33. *Downtown Taipei after Typhoon Billie lashed the city with 75 kt winds. (Courtesy of Central Weather Bureau, Taipei, Taiwan, Republic of China.)*


TYPHOON FRAN
BEST TRACK TC-17
03 SEP - 13 SEP 1976
MAX SFC WIND 130 KTS
MINIMUM SLP 915 MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
13/12Z
03/12Z
SHANGHAI
SEOUL
TOKYO
TAIPEI
MANILA
CHICHI JIMA
IWO JIMA
MARCUS
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
TRUK
PONAPE

Fran, the 17th storm of the season, began as an innocuous area of convective activity in the monsoon trough. Its life span of 10 days included development to super typhoon intensity and a destructive passage through the Japanese archipelago.

First detected on the afternoon of the 1st of September as an area of convective activity 200 nm northeast of Ponape, the system was monitored for 2 days before exhibiting any significant development. The initial warning on TD 17 was issued at 1200Z on the 3rd after satellite data indicated the disturbance had strengthened, and further intensification was expected. The depression was upgraded to Tropical Storm Fran after reconnaissance aircraft at 0339Z on the 4th recorded a central pressure of 997 mb. Aircraft data further indicated that the storm was heading northwestward at 11 kt. Mid-tropospheric synoptic data showed a weakness in the subtropical ridge south of Japan, toward which Fran was moving.

By 0000Z on the 5th the storm was 90 nm south of Guam, continuing on its northwestward track. Nine hours later Fran passed 20 nm west of Guam. A maximum sustained wind of 30 kt with gusts to 41 kt was reported on the island. By the morning of the 6th Fran had intensified to 60 kt while moving toward the northwest at 14 kt (Fig. 4-34). At 0245Z aircraft reported that the storm was some 250 nm north-northwest of Guam. During this reconnaissance flight maximum surface winds were estimated at 65 kt and a circular eye 30 nm in diameter was observed. Based on this information and a recorded central pressure of 977 mb, Tropical Storm Fran was upgraded to a typhoon.

As Fran reached typhoon intensity, upper tropospheric data indicated development of two anticyclones to the north and east of the storm which acted to suppress outflow from the northeast semicircle of the typhoon. By the morning of the 7th the anticyclones had dissipated, allowing unhindered outflow. This outflow was enhanced by the deepening of a short wave trough over central China which produced a highly efficient link to the mid-latitude westerlies. In response Fran began to deepen explosively. On the 7th at 0307Z reconnaissance aircraft recorded a central pressure of 916 mb and observed maximum surface winds estimated at 130 kt. During the previous 12 hours the central pressure dropped 43 mb, a rate of 3.6 mb per hour.

For 24 hours the upper tropospheric outflow remained unhindered, permitting the storm to maintain its maximum 130 kt super typhoon intensity (Fig. 4-35). On the 7th at 2109Z the central pressure reached its

FIGURE 4-34. *Fran at 60 kt intensity 190 nm northwest of Guam, 5 September 1976, 2150Z. (DMSP imagery)*

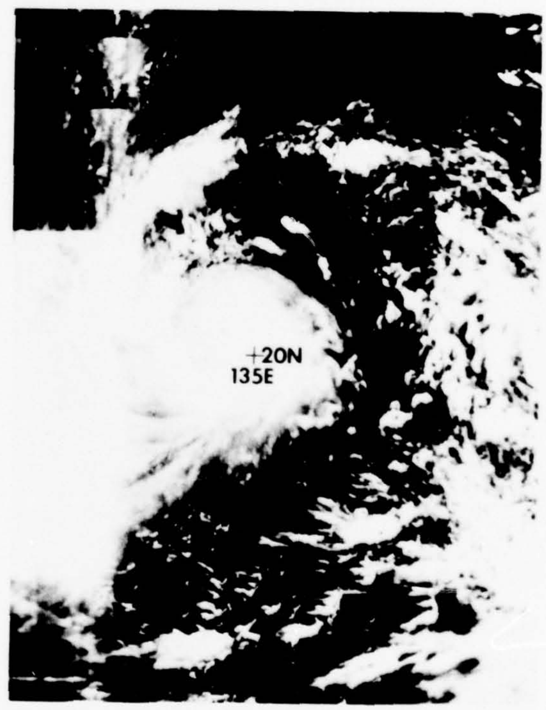


FIGURE 4-35. *Moonlight photograph of Super Typhoon Fran with winds near 130 kt 450 nm southeast of Kadena AB, Okinawa, 7 September 1976, 1023Z. (DMSP imagery)*

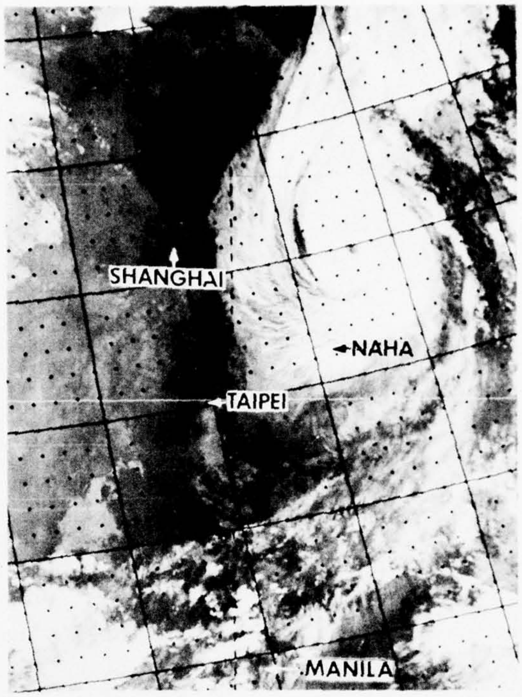


FIGURE 4-36. Inverted infrared photograph of Typhoon Fran during period of erratic movement with 90 kt intensity 210 nm north-northeast of Kadena AB, Okinawa, 10 September 1976, 1129Z. (DMSP imagery)

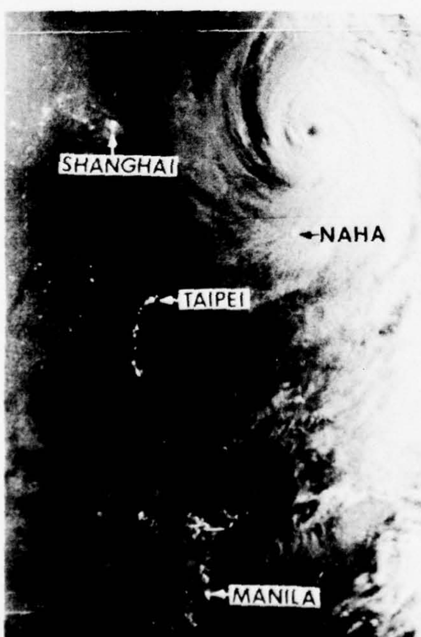


FIGURE 4-36a. Moonlight visual presentation of Figure 4-36. Bright areas are city lights and bright horizontal lines are lightning discharges. (DMSP imagery)

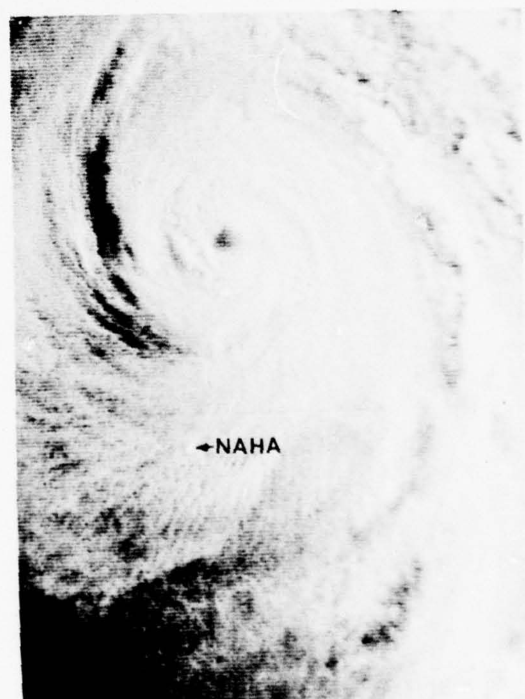


FIGURE 4-36b. Figure 4-36a expanded.

lowest observed level of 913 mb.

As the short wave trough northwest of Fran moved eastward, northeasterly flow from the upper level Asian anticyclone began to hinder outflow in the western semicircle of the storm. Consequently, by the evening of the 8th the storm had weakened to 125 kt, and had begun to move northward in response to the retrogression of an upper tropospheric short-wave trough to a position west of the storm.

As Fran traveled through the Ryukyu Islands, it passed 60 nm east of Okinawa. Naha (47930) recorded a maximum sustained surface wind of 55 kt with gusts to 73 kt. Some damage was experienced at Kadena AB on Okinawa.

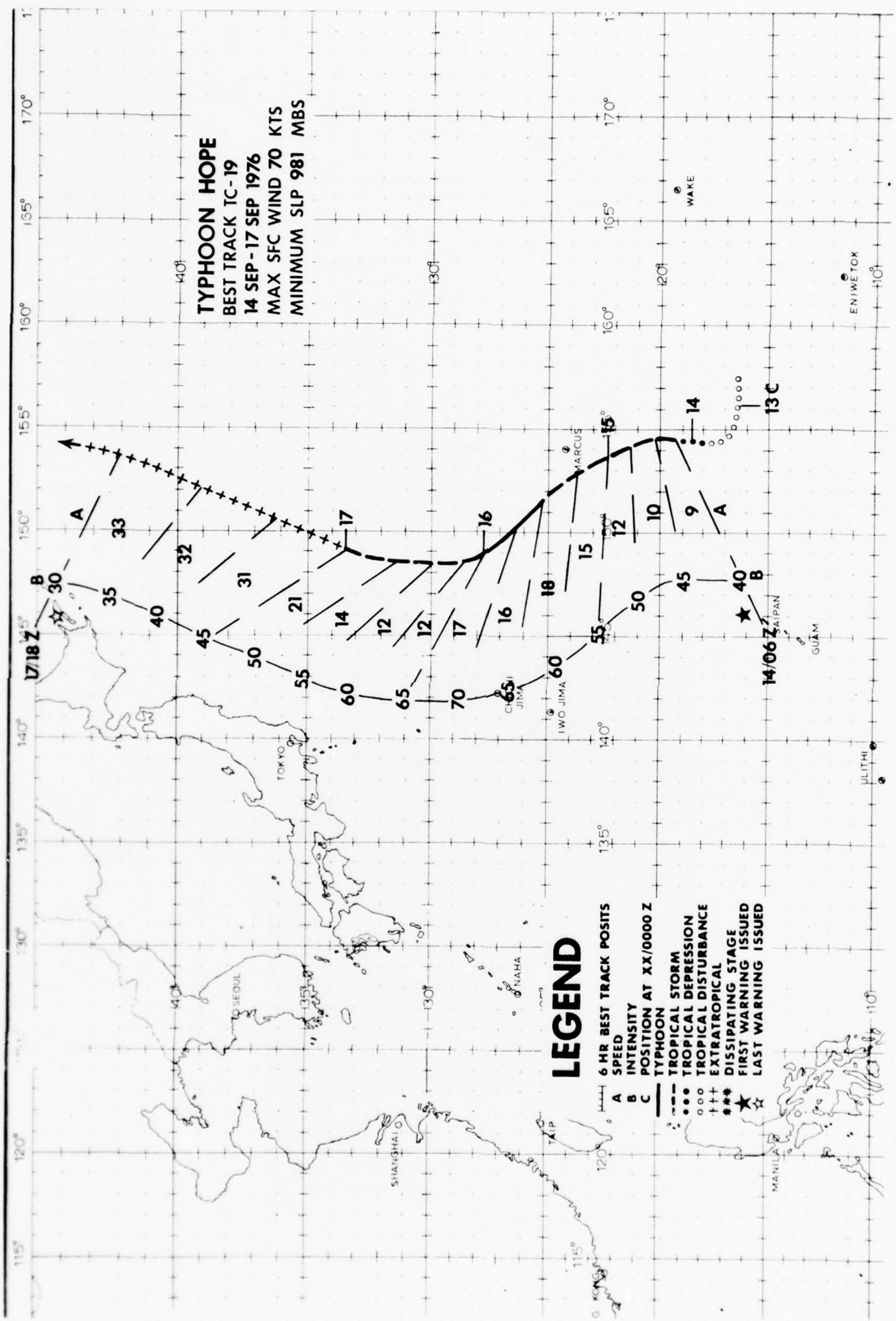
By the evening of the 10th Fran had slowed to 2 kt (Fig. 4-36, Fig. 4-36a, and Fig. 4-36b), and during the subsequent 36 hours drifted on an erratic path toward the west. On the night of the 11th Fran began to accelerate northward (Fig. 4-37) and by the following morning was moving toward the north-northeast at 7 kt. These irregular movements were apparently in response to east-west oscillations of the upper tropospheric short-wave trough north of the storm.

During this period of slow, erratic movement the storm's destructive winds caused several maritime mishaps. JICS, a ship of Panamanian registry, ran aground at Tibjima, Minamata Bay on September 12th and the Kyoyu Maru reportedly broke in two in the Bungo Straits on the 11th.

On the afternoon of the 12th the storm accelerated and moved toward the north-northeast in response to a deepening upper tropospheric trough over central China. Passing over Kyushu on the evening of the 12th, Typhoon Fran had weakened to tropical storm intensity. Twelve hours later, as the storm traveled over the cooler Sea of Japan, it lost its tropical features becoming extratropical at 0600Z on the 13th.

Typhoon Fran's slow movement through the Tokara Island group, over Kyushu, and into the Sea of Japan caused significant damage and loss of life. It was reported to be the most destructive tropical cyclone affecting Japan in the last 10 years. The Japanese National Police Agency confirmed a total of 133 persons dead, 32 missing and 227 injured as a result of Fran's torrential rains and strong winds. According to the Japan Times of 15 September, damage to private and public facilities was estimated at approximately $572 million.

FIGURE 4-37. *Infrared photograph of Typhoon Fran at 75 kt 190 nm south-southwest of Sasebo, 11 September 1976, 1116Z. (DMSP imagery)*


TYPHOON HOPE
BEST TRACK TC-19
14 SEP-17 SEP 1976
MAX SFC WIND 70 KTS
MINIMUM SLP 981 MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
17/18 Z
14/06 Z
WAKE
ENIWETOK
MARCUS
IWO JIMA
SAIPAN
GUAM
ULITHI
TOKYO
SEOUL
NAHA
SHANGHAI
MANILA

Hope, the 11th typhoon of the season, developed in a region of intense cyclonic shear produced by a deep southwesterly monsoon surge. Not since August 1974, during the similar development of Typhoon Mary, has the western Pacific experienced such a deep and prolonged southwesterly monsoon flow. The disturbance soon to become Typhoon Hope was first detected near 17N-157E on the morning of the 13th of September as a region of deep, but unorganized, convection at the eastern edge of the intense monsoon trough. This same trough had spawned Tropical Storm Georgia four days earlier.

By the following morning the disturbance exhibited much better organization (Fig. 4-38) and a Tropical Cyclone Formation Alert was issued at 0044Z on the 14th. At 0600Z the American Chieftain (WJNA) 125 nm northeast of Hope, reported 45 kt southeasterly winds and a minimum sea level pressure of 998.7 mb. Some 200 nm south-southeast of the system, the American Lynx (WZJE) reported 40 kt winds from the southwest and a minimum sea level pressure of 998.8 mb. The first warning on Tropical Storm Hope was issued at 0702Z.

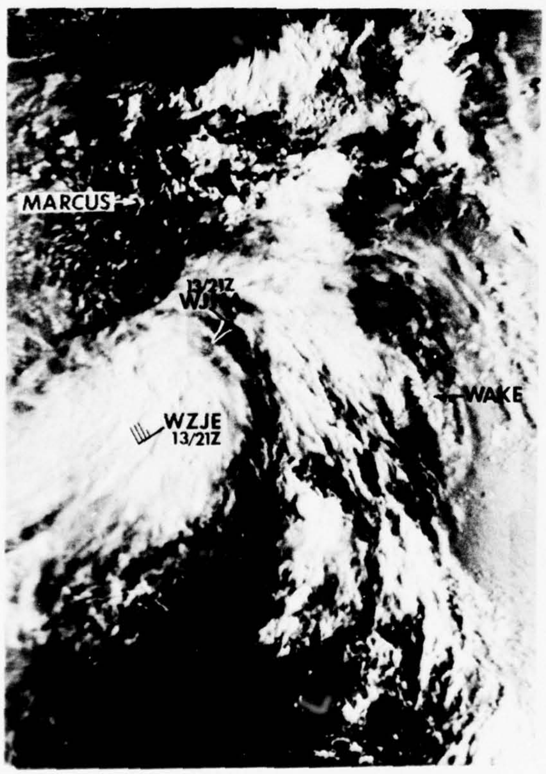


FIGURE 4-38. *Hope approaching tropical storm intensity 340 nm south of Marcus, 13 September 1976, 2013Z. Gale force winds were observed in the east semi-circle of the system illustrating the intensity of the monsoon trough. (DMSP imagery)*

Reconnaissance aircraft at 0847Z on the 14th indicated a central pressure of 995 mb and testified to the large asymmetrical character of this cyclone. Maximum winds in the western quadrant were found to be only 20 kt while ships in the east semicircle reported winds of 45 kt 250 nm from the storm.

During the subsequent 2 days Hope accelerated to the north-northwest toward a weakness in the mid-tropospheric subtropical ridge, a weakness created by the combined effects of a 500 mb trough located above Japan and an active Tropical Upper Tropospheric Trough (TUTT), oriented northeast-southwest, west of Marcus Island. At 0240Z on the 14th reconnaissance aircraft observed the minimum recorded sea level pressure of 981 mb and indicated that the north-northwestward movement of Hope had increased to 15 kt. At 0300Z, Marcus Island reported maximum sustained surface winds of 54 kt, a minimum sea level pressure of 988.6 mb and a 3-hourly pressure fall of 7.7 mb as the typhoon passed 90 nm south-southwest.

Hope attained its maximum intensity of 70 kt about 1800Z on the 15th, approximately 240 nm northwest of Marcus (Fig. 4-39). During the morning of the 16th Typhoon Hope began to weaken as it slowed to 12 kt and began to traverse the mid-tropospheric subtropical ridge. Twenty-four hours later the storm had weakened to 45 kt and was moving toward the north-northeast at a speed in excess of 30 kt. The final warning was issued at 1800Z on the 17th when strong shear, cooler sea surface temperatures, and incursion of cool air had stripped Hope of its tropical nature.

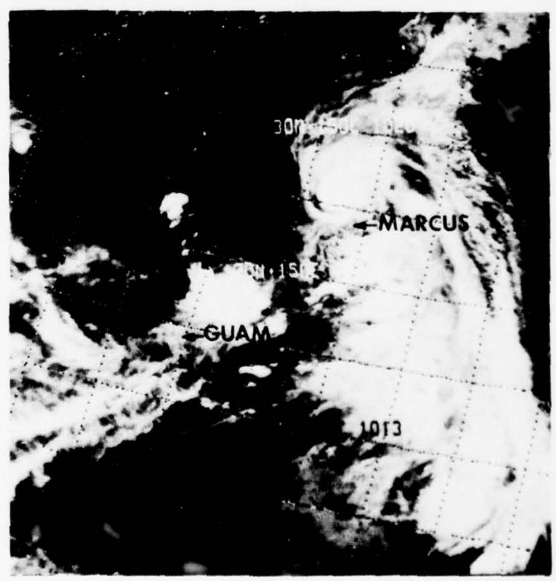
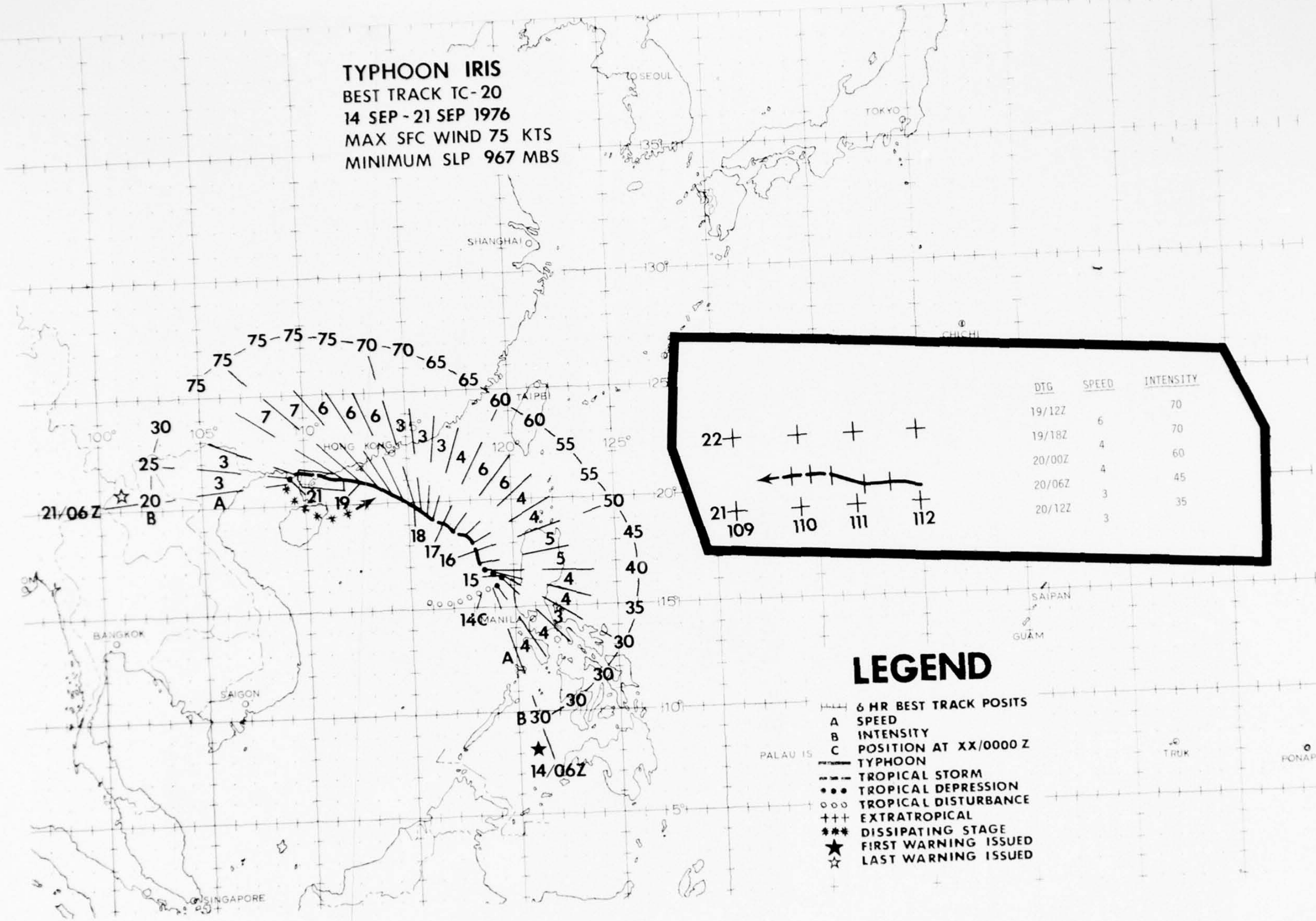


FIGURE 4-39. *Inverted infrared photograph of Hope approaching typhoon intensity 110 nm west-northwest of Marcus, 15 September 1976, 1018Z. The remnants of Tropical Storm Georgia appear northeast of Guam. (NOAA-4 imagery)*


TYPHOON IRIS
BEST TRACK TC-20
14 SEP - 21 SEP 1976
MAX SFC WIND 75 KTS
MINIMUM SLP 967 MBS
SEOUL
TOKYO
SHANGHAI
TAIPEI
HONG KONG
MANILA
BANGKOK
SAIGON
SINGAPORE
CHICHI
SAIPAN
GUAM
PALAU IS
TRUK
PONAPE
21/06Z
14/06Z
DTG
SPEED
INTENSITY
19/12Z
19/18Z
20/00Z
20/06Z
20/12Z
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED

On the 13th of September satellites gave the first indications of what was to become the only typhoon of the year to originate in the South China Sea. At 0140Z on the 14th a tropical cyclone formation alert was issued for an area west of Manila, and at 0600Z the first warning on TD 20 was issued.

During this period the synoptic situation was characterized by low pressure over Southeast Asia and an enhanced southwest monsoon over the southern South China Sea. At the mid-tropospheric level short wave troughs were passing from west to east well north of the storm. With a lack of significant steering flow TD 20 began to drift slowly northward. By 0600Z on the 15th satellite and synoptic data indicated some intensification, and the tropical depression was upgraded to Tropical Storm Iris (Fig. 4-40).

By the evening of the 16th, a weak mid-tropospheric ridge had begun to build north of Iris causing the storm to turn northwestward toward southern China. An upper tropospheric trough northwest of Iris enhanced outflow to the north, allowing the system to intensify to typhoon intensity by 0600Z on the 17th. Aircraft reconnaissance at 0420Z observed typhoon strength surface winds 40 nm southeast of the storm center and recorded a central pressure of 983 mb. At 1200Z Pratas Island (59981) recorded winds of 40 kt and a sea level pressure of 997.3 mb. Three hours later, Iris with maximum winds of 75 kt passed 90 nm south-southwest of the island. At 2100Z Pratas recorded a minimum sea level pressure of 997.1 mb and winds of 33 kt. As Iris continued toward the southeastern coast of Asia it became further influenced by the subtropical ridge to the north, the typhoon turned more westward and accelerated to 7 kt (Fig. 4-41). At 0600Z on the 19th Iris, still maintaining 75 kt winds, passed 35 nm south of Shan-Ch'uan-Tao (59673) where the station reported a sea level pressure of 988.1 mb and winds of 60 kt.

Typhoon Iris made landfall 30 nm north of Chancian (59755) on the Luichow Peninsula at 2100Z on the 19th. The cyclone dissipated rapidly as it crossed the peninsula. Fifteen hours later it had weakened to a 35 kt tropical storm and entered the Gulf of Tonkin. The final warning was issued at 0600Z on the 21st.

On the 18th, Iris had passed 90 nm south of Hong Kong, where 68 kt winds were observed. Hong Kong newspaper reports indicated that more than a dozen people were injured by flying debris. Also on the 18th, 50 nm east of Pratas and 50 nm north of the storm, the Chieh Lee, a 5000 ton Panamanian freighter, sank. According to newspaper reports, 13 crewmen were rescued while 4 were known dead and 11 others were missing.

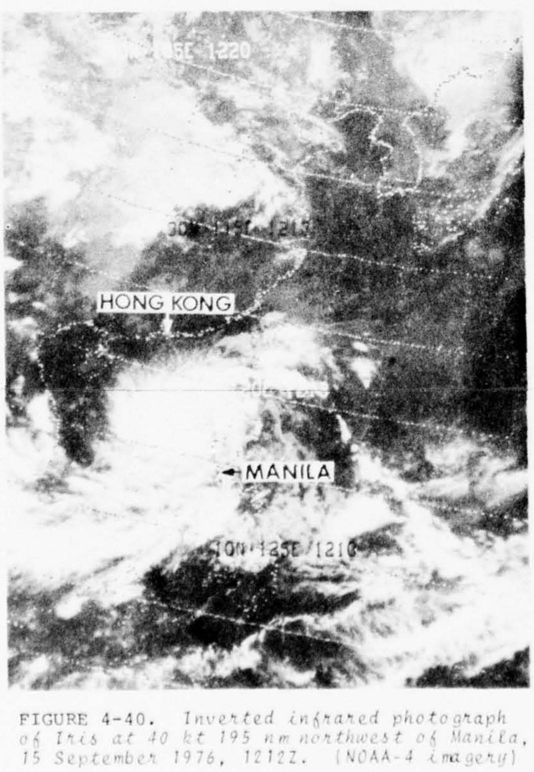


FIGURE 4-40. *Inverted infrared photograph of Iris at 40 kt 195 nm northwest of Manila, 15 September 1976, 1212Z. (NOAA-4 imagery)*

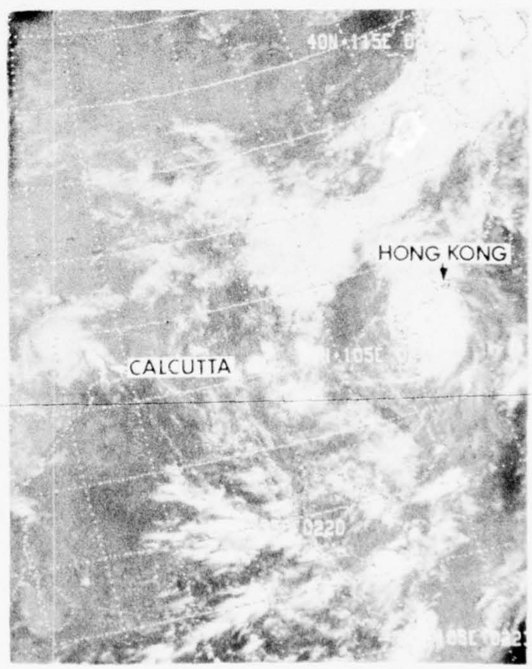
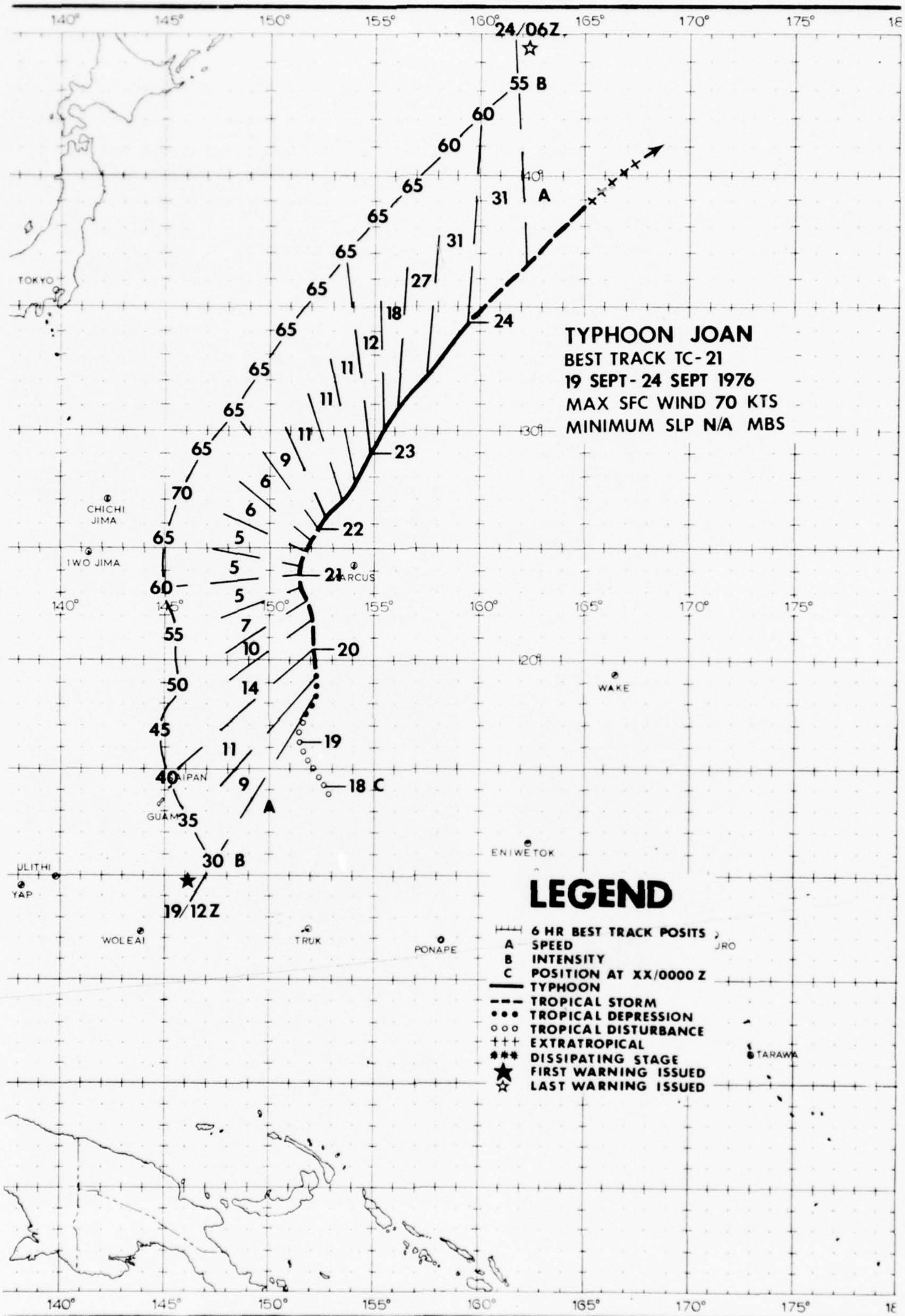


FIGURE 4-41. *Typhoon Iris (right) at 75 kt peak intensity 110 nm southwest of Hong Kong, 19 September 1976, 0216Z. Tropical Cyclone 23-76 is seen inland over India. (NOAA-5 imagery)*


TYPHOON JOAN
BEST TRACK TC-21
19 SEPT-24 SEPT 1976
MAX SFC WIND 70 KTS
MINIMUM SLP N/A MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
24/06Z
19/12Z
TOKYO
CHICHI JIMA
IWO JIMA
MARCUS
SAIPAN
GUAM
ULITHI
YAP
WOLEAI
TRUK
PONAPE
ENIWETOK
WAKE
TARAWA

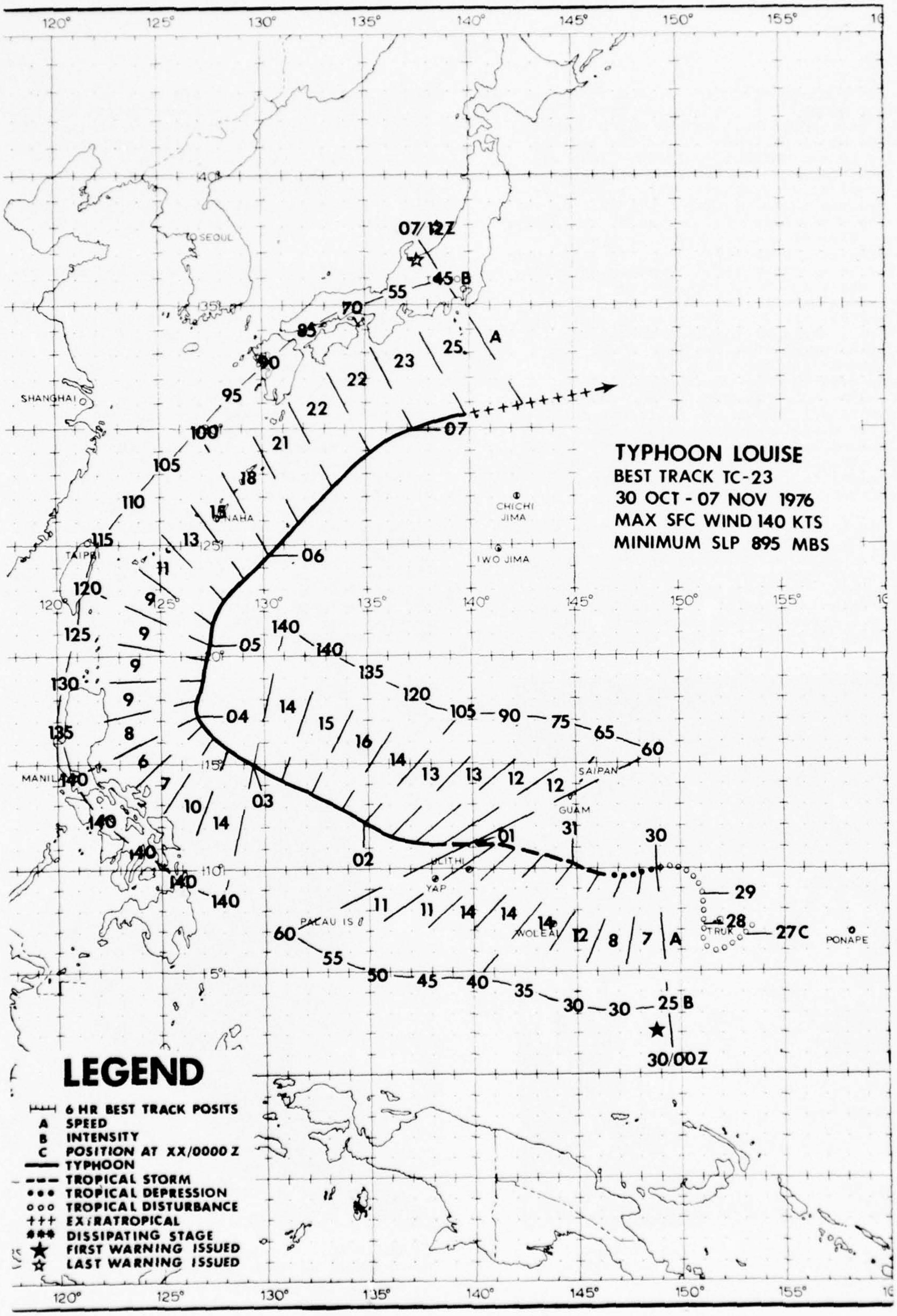
Destined to spend its entire life over the open ocean, Joan originated within an active near equatorial trough which extended from the coast of China across the western Pacific to the Marshall Islands. Joan was initially observed on the 17th of September as a tropical disturbance, with a weak surface cyclone centered near 13N 155E. At the time the disturbance was detected, the southwestern edge of a sharp Tropical Upper Tropospheric Trough (TUTT) was situated over the low level circulation creating unidirectional shear which suppressed growth of the upper level anticyclone above the system. By the 18th, the TUTT had receded northward allowing a small anticyclone to develop and permitting outflow to the west above the disturbance. By the 19th, the TUTT had receded even farther north allowing the anticyclone to fully develop and to generate outflow in all quadrants. With the outflow mechanism established, the disturbance intensified and became TD 21 on the 19th at 0600Z. At 1800Z on the 19th it was upgraded to Tropical Storm Joan, 325 nm south-southwest of Marcus Island (Fig. 4-42).

Initially, Joan tracked northward through a large break in the mid-tropospheric subtropical ridge which had persisted since the passage of Typhoon Hope the previous week. By the 20th, the ridge began to reestablish itself toward the northwest, forcing Joan to acquire a northwestward track during the subsequent 24 hours. During this period the storm intensified at a rate of 5 kt per 6 hours. On the 21st, Joan slowed its forward speed to 5 kt. As it approached the western extremity of the subtropical ridge it became evident that Joan would recurve toward the northeast. At this point the storm had a well developed outflow pattern with several convective bands consolidating around a central dense overcast approximately 1 degree in diameter.

By 0600Z on the 21st, Joan had attained typhoon intensity while at the midpoint of recurvature. Six hours later, Typhoon Joan attained its peak intensity of 70 kt (Fig. 4-43), and a distinct, well defined eye was visible on satellite data with tightly wrapped convective bands surrounding the center. At 0000Z on the 21st Joan passed 125 nm west of Marcus Island where 33 kt surface winds were observed. By the 22nd Joan had weakened slightly but maintained typhoon intensity as it accelerated to 11 kt toward the northeast. Firmly implanted in the mid-latitude southwesterlies ahead of a long wave trough moving slowly across Japan, Joan continued to track northeastward accelerating to 31 kt by the 24th. It became an extratropical system at 1200Z on the 24th. The remains of Typhoon Joan continued to disrupt shipping lanes in the western Pacific. A ship, UWGR, at 1200Z on the 24th reported sustained winds of 65 kt and a sea level pressure of 975 mb while located near 38N 165E, 60 nm east of the extratropical low.

FIGURE 4-42. *Joan just after attaining tropical storm intensity 300 nm south-southwest of Marcus, 19 September 1976, 2042Z. (DMSP imagery)*

FIGURE 4-43. *Infrared image of Typhoon Joan near its 70 kt peak intensity 130 nm west of Marcus, 21 September 1976, 0915Z. (DMSP imagery)*


TYPHOON LOUISE
BEST TRACK TC-23
30 OCT - 07 NOV 1976
MAX SFC WIND 140 KTS
MINIMUM SLP 895 MBS
LEGEND
6 HR BEST TRACK POSITS
A SPEED
B INTENSITY
C POSITION AT XX/0000 Z
TYPHOON
TROPICAL STORM
TROPICAL DEPRESSION
TROPICAL DISTURBANCE
EXTRATROPICAL
DISSIPATING STAGE
FIRST WARNING ISSUED
LAST WARNING ISSUED
SEOUL
SHANGHAI
TAIPEI
MANILA
NAHA
CHICHI JIMA
IWO JIMA
SAIPAN
GUAM
ULITHI
YAP
PALAU IS
WOLEAI
TRUK
PONAPE
07/12Z
30/00Z

Louise, the 14th and final typhoon of season, was also the most intense of 1976. The disturbance that was to become Louise was first detected by satellite data on the morning of 27 October about 75 nm east of Truk. During the next 3 days the disturbance showed little intensification as it meandered through the northern Truk District. Late on the 29th the system began moving toward the west, and by the morning of the 30th satellite data indicated that it was intensifying (Fig. 4-44). The first warning was issued at 0000Z on the 30th as TD 23.

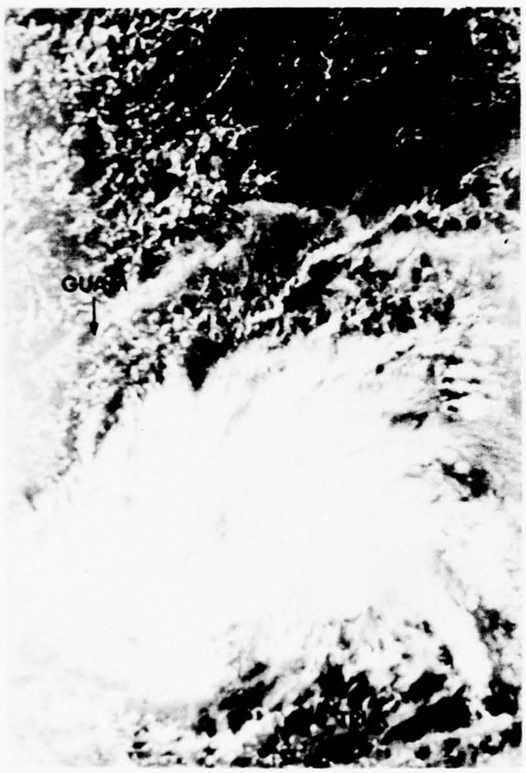


FIGURE 4-44. *Louise a few hours prior to becoming TD 23 150 nm northwest of Truk and 400 nm southeast of Guam, 29 October 1976, 2107Z. (DMSP imagery)*

Reconnaissance aircraft at 1515Z on the 30th indicated that the central pressure had fallen to 996 mb, and at 1800Z the depression was upgraded to Tropical Storm Louise. During the next 36 hours Louise moved west-northwestward at 14 kt, then westward at 11 kt as its winds increased at a rate of 5 kt every 6 hours. At 0311Z on the 1st of November aircraft observed 70 kt flight level winds and found that the central pressure of the storm had fallen to 976 mb. At 0600Z Louise was upgraded to a typhoon while 100 nm northwest of Ulithi Atoll.

Beginning on the 1st, a series of rapidly moving, mid-tropospheric short-wave troughs created a weakness in the subtropical ridge between 125E and 130E. On the afternoon of the 1st Louise began to respond to this weakness by acquiring a northwestward track. Almost simultaneoulsy, the typhoon commenced more rapid deepening, attaining 105 kt winds by the morning of the 2nd. From 0311Z on the 1st to 0310Z on the 2nd reconnaissance aircraft indicated a fall in the central pressure of 43 mb, a rate of 1.8 mb per hour. This deepening was in response to favorable upper-level outflow channels to the northeast and south (Fig. 4-45). Further deepening to 905 mb had occurred by 1435Z on the 2nd, a fall of 28 mb in 11 hours.

During the early morning of the 3rd Super Typhoon Louise attained its maximum intensity of 140 kt which it maintained for nearly 36 hours (Fig. 4-46). The lowest recorded pressure was 895 mb observed by aircraft at 0830Z on the 3rd (Fig. 4-47).

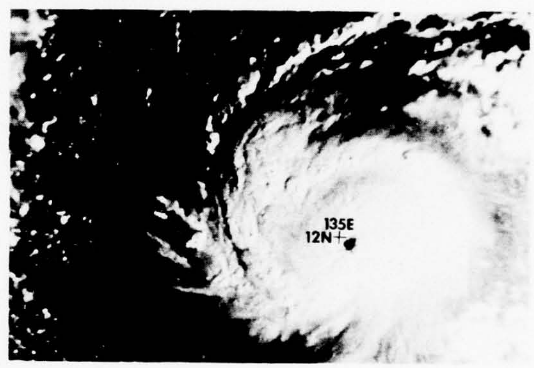


FIGURE 4-45. *Typhoon Louise at 100 kt intensity 240 nm west-northwest of Yap, 1 November 1976, 2212Z. (DMSP imagery)*

From the morning of 2nd until the afternoon of the 3rd Louise maintained its northwestward track moving at 14 to 16 kt. Then, on the afternoon of the 3rd, the storm slowed to 6 kt as it recurved around the western periphery of the mid-tropospheric subtropical ridge. By 0000Z on the 4th, Louise began to accelerate to 9 kt, moving in a north-northeastward direction and slowly weakening. Louise continued this movement for more than 30 hours as it traversed the broad axis of the subtropical ridge. Late on the afternoon of the 5th the typhoon, which had weakened to 115 kt, began to accelerate on a northeast track.

From 0000Z on the 4th until 1800Z on the 6th Louise weakened at the unusually slow rate of 5 kt per 6 hours. This slow weakening resulted from two conditions: (1) A broad surface high pressure cell centered over northern Honshu prevented significant

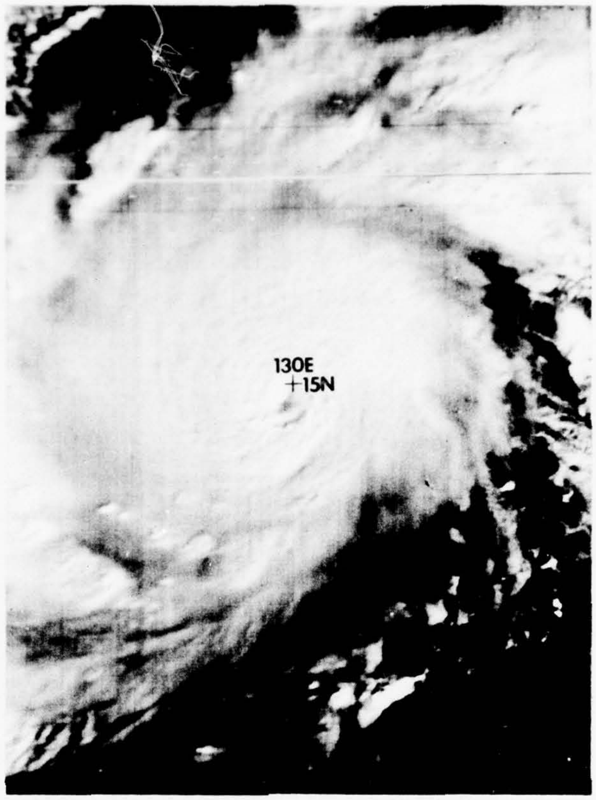


FIGURE 4-46. *Super Typhoon Louise at 140 kt peak intensity 500 nm east of Manila, 2 November 1976, 2318Z. (DMSP imagery)*

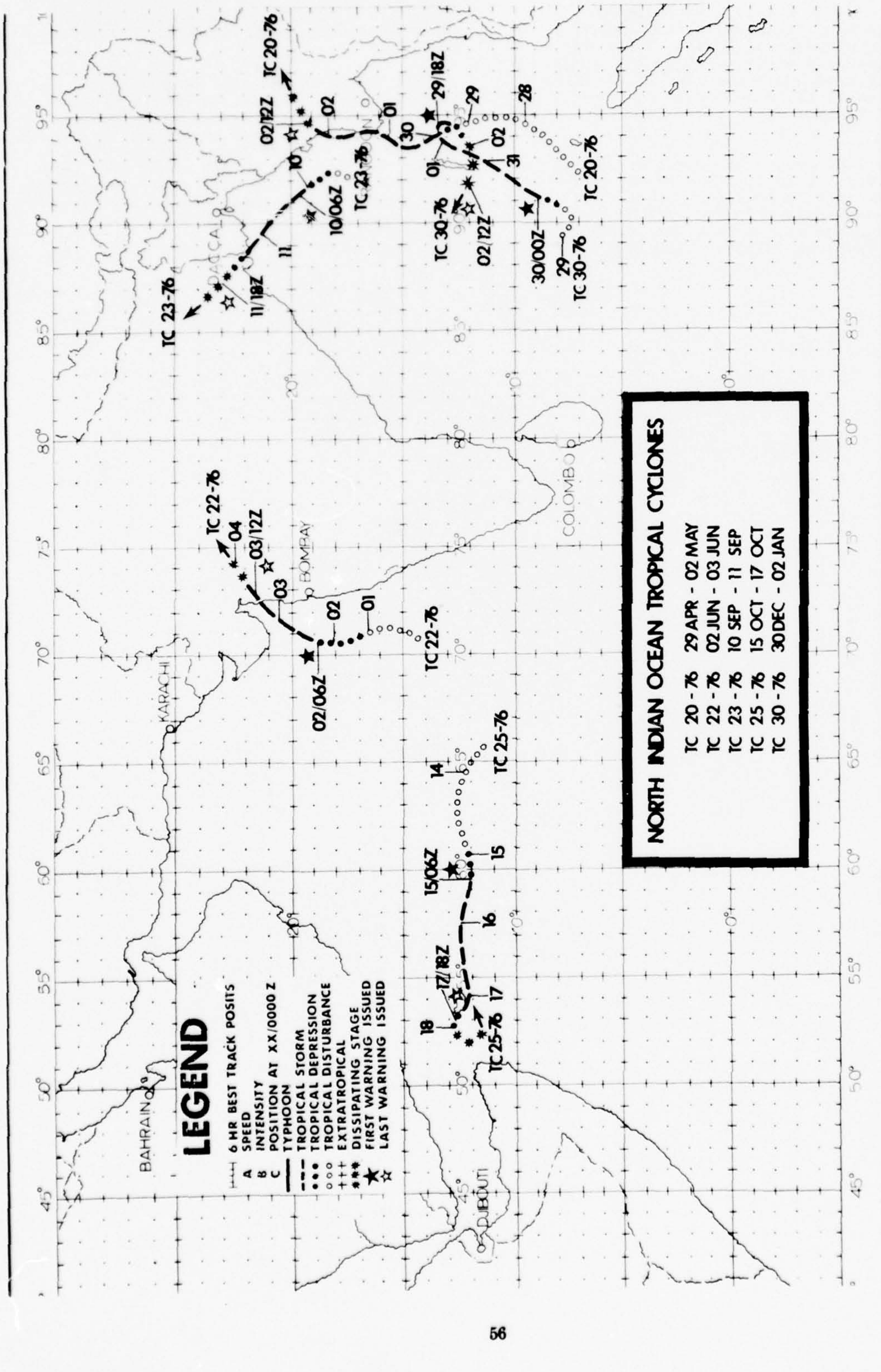
FIGURE 4-47. *Infrared photograph of Typhoon Louise at peak intensity 380 nm east-northeast of Manila and 615 nm south of Kadena AB, Okinawa, 3 November 1976, 1045Z. (DMSP imagery)*

equatorward penetration of frontal systems; and (2) The extremely strong jet stream (exceeding 200 kt) over eastern Japan provided an excellent outflow channel. At 0300Z on the 6th, Minamidaito Jima (47945), 40 nm north-northeast of Louise, reported east-northeasterly winds of 40 kt and a sea level pressure of 984.8 mb. Two hours later the storm passed 15 nm southeast of the island with maximum winds estimated near 95 kt.

By the 7th, cooler sea surface temperatures and very strong vertical shear were taking their toll as Louise moved north of 30N. Reconnaissance aircraft at 0359Z on the 7th indicated that Louise was rapidly losing its tropical character and was becoming extratropical. The Airborne Reconnaissance Weather Officer also observed that the lower half of the wall cloud was "rotating rapidly", a phenomenon sometimes reported when a storm is becoming extratropical.

At 0600Z on the 7th, moving east-northeast at 25 kt, Louise became extratropical. As an extratropical system the remains of Louise moved northward to combine with another surface low. The resulting system had deepened to 947 mb by the 10th and became one of the most severe extratropical storms of the year, ultimately producing surf in excess of 30 ft in the Hawaiian Islands.

4. NORTH INDIAN OCEAN TROPICAL CYCLONES



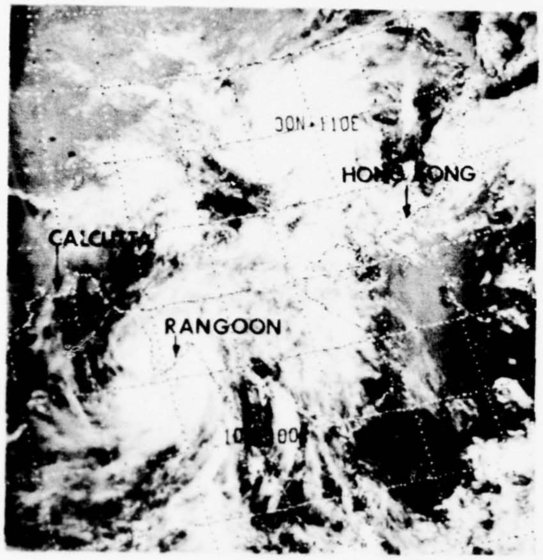


FIGURE 4-48. *Tropical Cyclone 20-76 entering southwestern Burma coast with 55 kt peak intensity 110 nm west-southwest of Rangoon, 1 May 1976, 0150Z. (NOAA-4 imagery)*

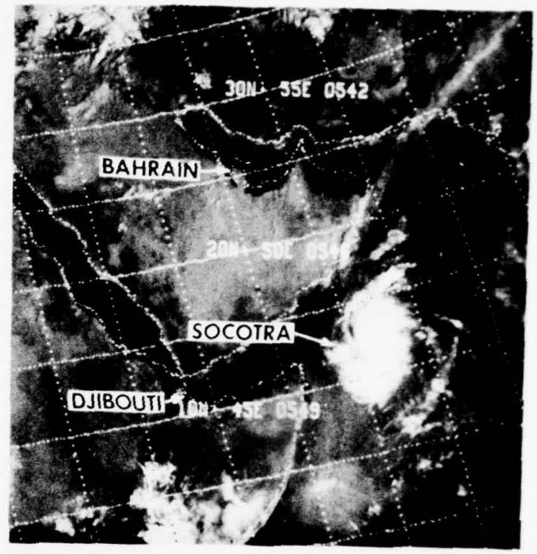


FIGURE 4-49. *Tropical Cyclone 25-76 at 50 kt peak intensity 110 nm east of Socotra, 16 October 1976, 0548Z. (NOAA-5 imagery)*

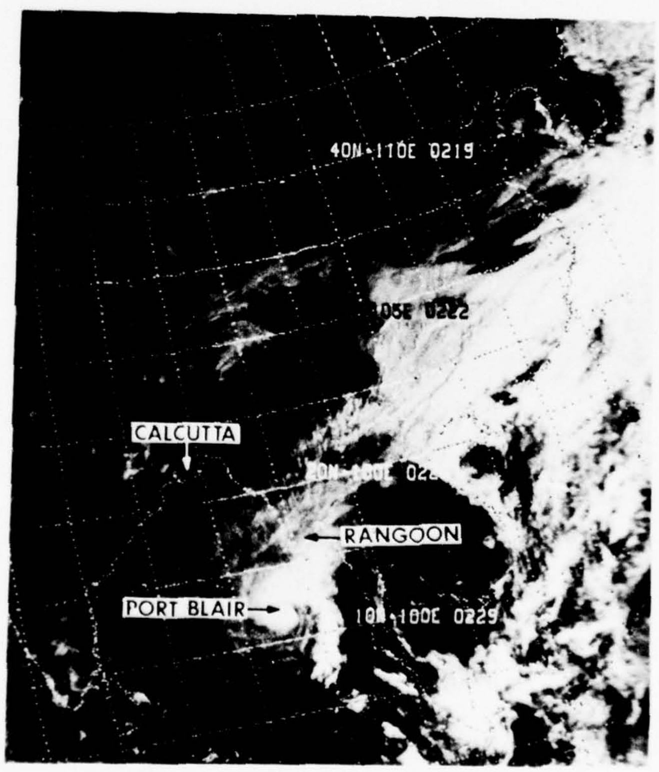
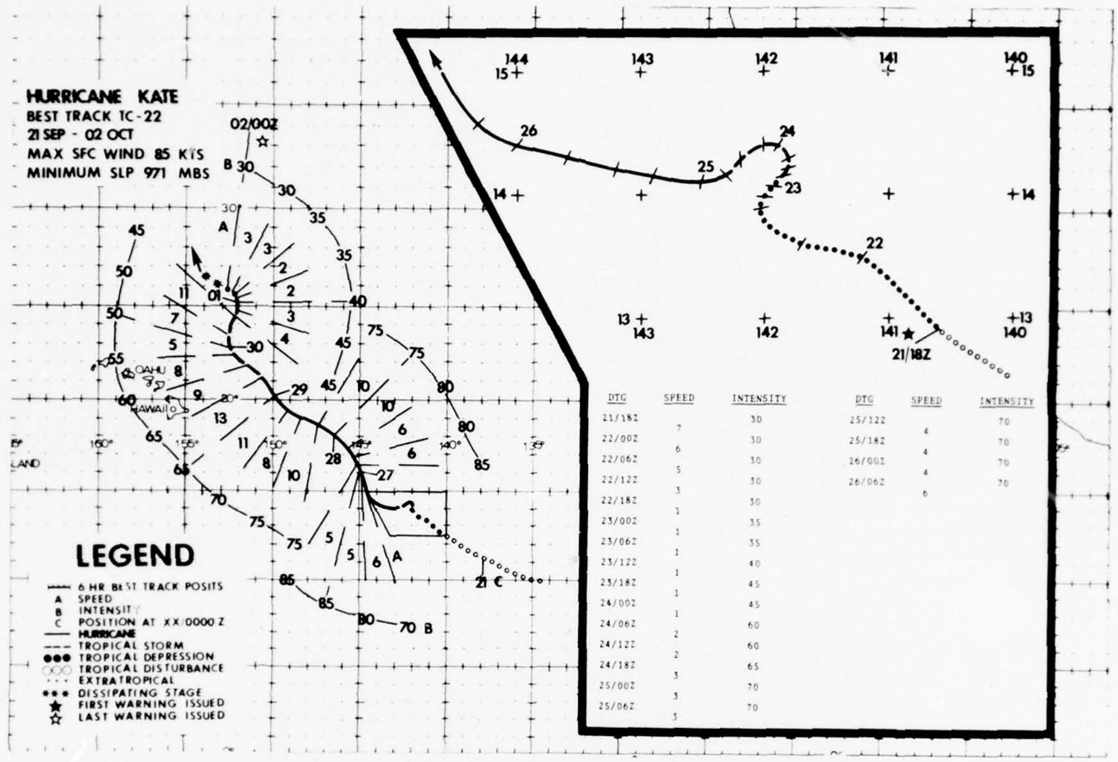


FIGURE 4-50. *Tropical Cyclone 30-76 at 55 kt peak intensity 25 nm southwest of Port Blair, 31 December 1976, 0228Z. (NOAA-5 imagery)*

5. CENTRAL NORTH PACIFIC TROPICAL CYCLONES



KATE[1]

Hurricane Kate, the only hurricane to develop in the Central Pacific during 1976, posed a threat to the Hawaiian Islands before it veered northwestward about a day's distance from the island of Hawaii. Seas generated by the hurricane caused surf up to 15 feet along the northern and eastern shores of Hawaii, Maui and Oahu, but no significant damage was reported.

The storm which was later named Kate was spawned on September 20th in the usually absent Central North Pacific near equatorial trough. Other weak vortices were observed in this trough during the period of Kate but did not develop.

The Central Pacific Hurricane Center issued the first bulletin on TD 22 on the morning of the 21st. A ship, URFJ, reported 30 kt southwest winds 150 nm southwest of the center of the tropical depression.

The depression's previous northwest track stopped on the morning of the 22nd and the storm gradually intensified, becoming Hurricane Kate on the morning of the 24th, very near its position 48 hours earlier. Kate then slowly travelled westward for a day before sharply veering north-northwestward.

On the evening of the 25th, a ship, ATAY, about 120 nm south of Kate, reported 25 kt west winds indicating that the strong winds in Kate were tightly wound near its center. Attaining maximum winds of 85 kt on the afternoon of the 26th 600 nm east-southeast of Hawaii, Kate did not appear an immediate threat to the Hawaiian Islands (Fig. 4-51). However, by the following day it had turned northwest, and on the morning of he 28th was positioned only 330 nm due east of Hawaii. It was then expected to pass 150 nm northeast of the island.

However, during the 28th Kate veered slightly to the right of its expected path and passed harmlessly, 240 nm east-northeast of Hilo, Hawaii while it gradually weakened (Fig. 4-52). Kate finally turned north as a weak tropical storm and ended its career near 27N 154W as the upper air westerlies sheared its clouds and circulation.

[1]Extracted from report submitted by Meteorologist in Charge, NWS Forecast Office Honolulu, Hawaii.

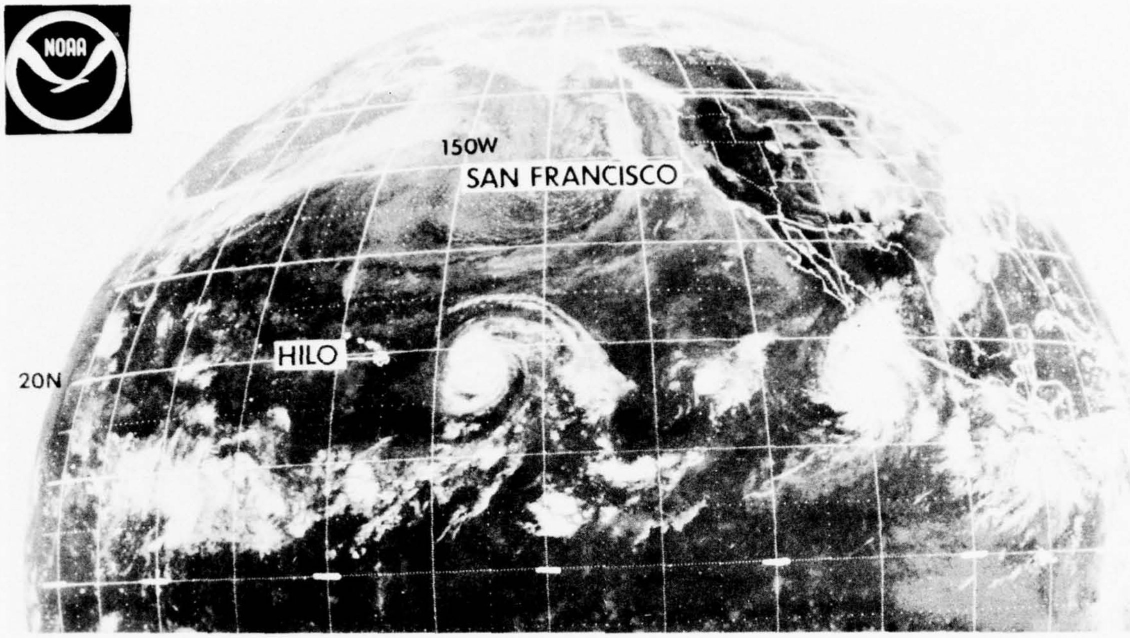


FIGURE 4-51. *Hurricane Kate (center) with 80 kt intensity 550 nm east-southeast of Hilo, Hawaii, while Hurricane Liza parallels the coast of Mexico, 27 September 1976, 1745Z. (SMS-2 imagery, Courtesy NOAA)*

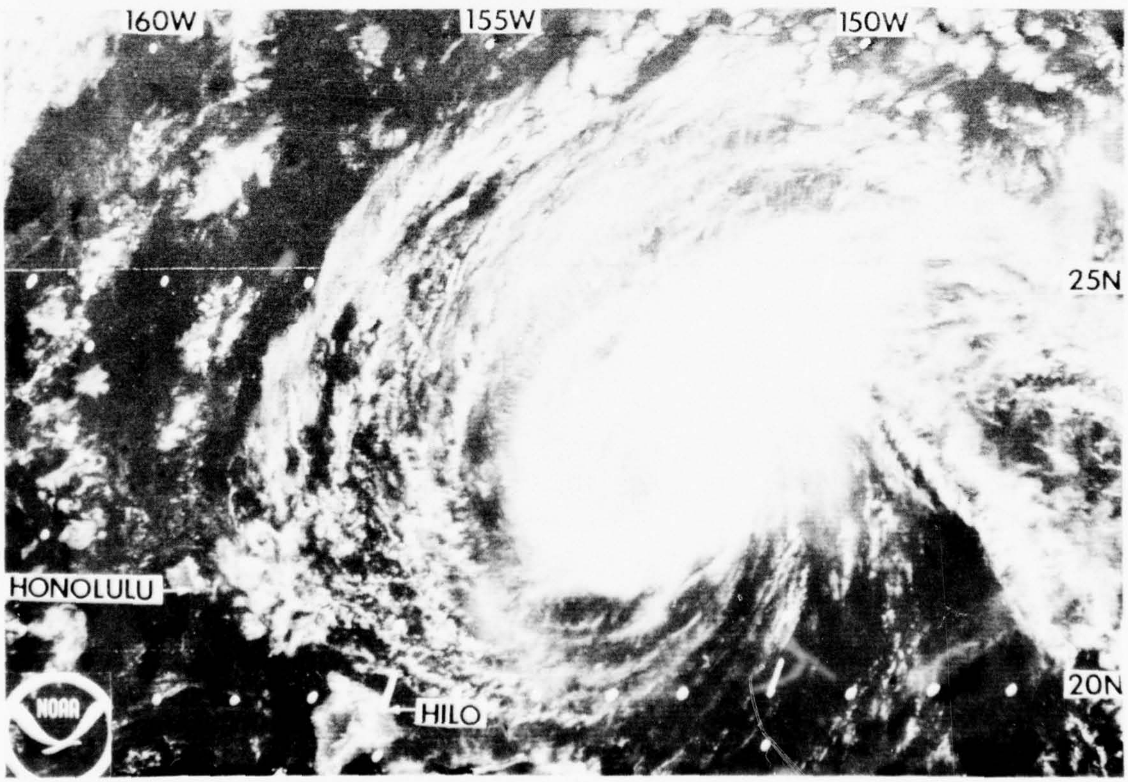


FIGURE 4-52. *Kate at 55 kt 230 nm northeast of Honolulu, 29 September 1976, 2015Z. (SMS-2 imagery, Courtesy NOAA)*

6. TROPICAL CYCLONE CENTER FIX DATA

Fix data for 1976 will be published in a separate Technical Note. This Tech Note will include fix data for all storms in the PACOM area west of 140W and north of the equator. To obtain a copy of this report write:

Commanding Officer
Fleet Weather Central/JTWC
COMNAVMARIANAS Box 12
FPO San Francisco 96630

CHAPTER V – SUMMARY OF FORECAST VERIFICATION DATA

1. ANNUAL FORECAST VERIFICATION

a. POSITION FORECAST VERIFICATION

Forecast positions for the warning, 24-, 48-, and 72-hour forecasts are verified against the best track. Positions for storms over land, dissipated or extratropical are not verified. In addition to the overall verifications depicted in Table 5-1, a separate verification for only Pacific Area typhoons is computed. This information is listed in Table 5-2, for comparison with previous years. This same information is depicted graphically in Figure 5-1. A computation of closest distance to the best track (right angle error) is also calculated. Right angle error, graphically depicted in Figure 5-2, is a measure of ability to forecast the path of motion without regard to speed. In the Indian Ocean Area, no 72-hour forecasts are available for verification, and no attempt is made to segregate storms by intensity. Error statistics for this area are summarized in Tables 5-2 and 5-3 and Figure 5-3.

b. INTENSITY FORECAST VERIFICATION

Intensity verification statistics for tropical cyclones attaining typhoon intensity are depicted in Table 5-4. Adherence to a standardized pressure-height versus wind speed relationship and improved satellite analysis techniques have resulted in a low initial position intensity error (4.3 kt) over the past three seasons. This in turn has contributed to smaller 24-, 48-, and 72-hour intensity forecast deviations from the JTWC best track.

2. COMPARISON OF OBJECTIVE TECHNIQUES

a. GENERAL

Objective techniques have been verified annually since 1967, however year-to-year modifications and improvements prevent any long term comparisons of the various techniques. The analog technique provides three movement forecasts, one for straight moving storms, one for recurving storms and one combining the tracks of straight, recurving and other storms that do not meet the criteria as straight or recurving analogs. However, only the combined is listed for verification. The analog technique also provides an intensity forecast for each warning position. The dynamic objective technique employs the steering concept of a point vortex in a smoothed large-scale flow field. An intensity forecast scheme is based on statistical regression equations of analog storms.

b. DESCRIPTION OF OBJECTIVE TECHNIQUES

(1) TYFN75-Analog program which scans history tapes for storms similar (within a specified acceptance envelope) to the instant storm. Three 24-, 48-, and 72-hour forecasts are provided. In addition 24-, 48-, and 72-hour intensity forecasts are provided.

(2) MOHATT 700/500-Steering program which advects a point vortex on a preselected analysis or smoothed prognostic fields at the designated upper-levels in 6-hour time steps through 72 hours. Utilizing the previous 12-hour history position, MOHATT computes the 12-hour forecast error and applies a bias correction to the forecast position.

TABLE 5-1. 1976 JTWC ERROR SUMMARY FOR THE WESTERN NORTH PACIFIC

		WARNING			24 HOUR			48 HOUR			72 HOUR		
	CYCLONE	POSIT ERROR	RT ANGLE ERROR	# WRNGS	FCST ERROR	RT ANGLE ERROR	# WRNGS	FCST ERROR	RT ANGLE ERROR	# WRNGS	FCST ERROR	RT ANGLE ERROR	# WRNGS
1.	TY KATHY	36	18	19	135	75	15	332	180	11	556	291	7
2.	TS LORNA	47	24	8	134	54	4	--	--	--	--	--	--
3.	TY MARIE	21	11	42	112	75	38	236	157	34	379	260	30
4.	TS NANCY	29	19	27	122	74	23	237	147	19	475	292	15
5.	TY OLGA	33	22	57	97	60	53	185	101	49	275	164	45
6.	STY PAMELA	29	15	49	123	66	45	203	119	41	237	126	37
7.	TY RUBY	24	17	43	117	64	39	228	147	33	299	175	23
8.	TY SALLY	27	16	35	139	78	31	331	192	27	572	334	23
9.	STY THERESE	19	10	37	115	75	33	218	146	29	319	203	25
10.	TS VIOLET	33	23	20	129	103	16	215	136	12	175	110	5
11.	TS WILDA	72	39	9	273	148	5	576	161	1	--	--	--
12.	TY ANITA	28	18	9	182	77	5	560	163	1		--	--
13.	TY BILLIE	15	10	31	111	67	27	240	130	23	278	126	19
14.	TS CLARA	15	8	7	102	40	3	--	--	--	--	--	--
15.	TS DOT	28	9	18	104	48	14	233	123	9	379	208	4
16.	TS ELLEN	36	23	14	89	50	10	141	69	6	282	99	2
17.	STY FRAN	16	8	41	130	66	37	258	109	33	422	212	29
18.	TS GEORGIA	28	16	19	83	38	15	130	56	11	232	153	7
19.	TY HOPE	34	20	12	173	77	8	350	82	4	--	--	--
20.	TY IRIS	17	11	25	91	58	21	182	105	17	316	202	13
21.	TY JOAN	46	25	20	140	102	16	244	156	12	363	291	8
22.	KATE			(CENTRAL PACIFIC HURRICANE CENTER)									
23.	STY LOUISE	16	12	35	102	69	31	203	112	27	260	139	23
24.	TS MARGE	54	27	21	120	76	17	300	178	13	416	327	9
25.	TS NORA	21	10	20	96	63	17	184	132	13	249	125	9
26.	TS OPAL	18	14	7	161	152	3	--	--	--	--	--	--
	ALL FORECASTS	27	16	625	117	71	526	230	132	425	338	202	333
	TYPHOONS ONLY (WHILE WINDS OVER 35 KNOTS)	24	14	419	117	71	390	232	133	333	336	194	277

TABLE 5-2. JTWC ANNUAL AVERAGE POSITION FORECAST ERROR FOR TROPICAL CYCLONES WHILE WINDS OVER 35 KNOTS

	WESTERN NORTH PACIFIC**			INDIAN OCEAN***	
	24-HR	48-HR	72-HR	24-HR	48-HR
1950-58	170	---	---	---	---
1959	*117	*267	---	---	---
1960	177	354	---	---	---
1961	136	274	---	---	---
1962	144	287	476	---	---
1963	127	246	374	---	---
1964	133	284	429	---	---
1965	151	303	418	---	---
1966	136	280	432	---	---
1967	125	276	414	---	---
1968	105	229	337	---	---
1969	111	237	349	---	---
1970	98	181	272	---	---
1971	99	203	308	220	410
1972	116	245	382	193	233
1973	102	193	245	203	305
1974	114	218	351	137	238
1975	129	279	442	145	228
1976	117	232	336	138	204

*FORECAST POSITIONS NORTH OF 35^{o}N WERE NOT VERIFIED.
**FOR TYPHOONS ONLY
***1971-1974 DOES NOT INCLUDE ARABIAN SEA

TABLE 5-3. 1976 JTWC ERROR SUMMARY FOR THE NORTH INDIAN OCEAN

	WARNINGS			24 HOUR			48 HOUR		
	POSIT ERROR	RT ANGLE ERROR	# WRNGS	FCST ERROR	RT ANGLE ERROR	# WRNGS	FCST ERROR	RT ANGLE ERROR	# WRNGS
TC 20-76	31	12	6	201	162	4	157	107	2
TC 22-76	28	18	3	56	41	1	---	---	---
TC 23-76	35	13	4	71	34	2	---	---	---
TC 25-76	59	40	6	109	99	4	244	230	2
TC 30-76	64	43	7	154	114	5	209	147	3
ALL FCSTS	46	28	26	138	108	6	204	159	7

TABLE 5-4. JTWC ANNUAL AVERAGE INTENSITY FORECAST ERROR

	WESTERN NORTH PACIFIC*				INDIAN OCEAN**		
	WARNING POSITION	24-HR	48-HR	72-HR	WARNING POSITION	24-HR	48-HR
1971	7	16	21	24	--	--	--
1972	9	14	20	24	13	15	12
1973	7	16	20	28	8	15	20
1974	4	11	15	20	0	8	18
1975	4	13	18	20	7	14	18
1976	5	12	19	22	5	10	15
AVG	6	14	19	23	7	12	17

*FOR TYPHOONS ONLY
**1971-1974 DOES NOT INCLUDE ARABIAN SEA

(3) FCSTINT-*Intensity forecast program* which utilizes statistical regression equations to provide 24-, 48-, and 72-hour forecast intensities.

(4) 12-HR EXTRAPOLATION-A track through current warning position and 12-hour old preliminary best track position is linearly extrapolated to 24 and 48 hours.

(5) HPAC-Mean 24 and 48 hour forecast positions are derived by averaging the 24 and 48 hour positions from the 12-HR EXTRAPOLATION track and a track based on climatology.

(6) XT24-Similar to 12-HR EXTRAPOLATION, except 24 hr old preliminary best track and latest fix position are used. Rather than linear extrapolation, the actual forecast speed of movement is used.

(7) INJAH74-Analog program for North Indian Ocean. Similar to TYFN75, except tracks are not segregated.

c. TESTING AND RESULTS

It is of interest to compare the performance of the objective techniques to each other and to the official forecast as well. This information is listed in Table 5-5 for Pacific typhoons only and in Table 5-6 for all Pacific forecasts.

In these tables "X-AXIS" refers to the techniques listed horizontally across the top, while "Y-AXIS" refers to those listed vertically. As a matter of explanation, the example shown in Table 5-5 compares TYFC to XT24. In the 182 cases available for comparison, the average 24 hour vector error for TYFC was 126 nm, while that for XT24 was 133 nm. The difference of -7 nm is shown in the lower right.

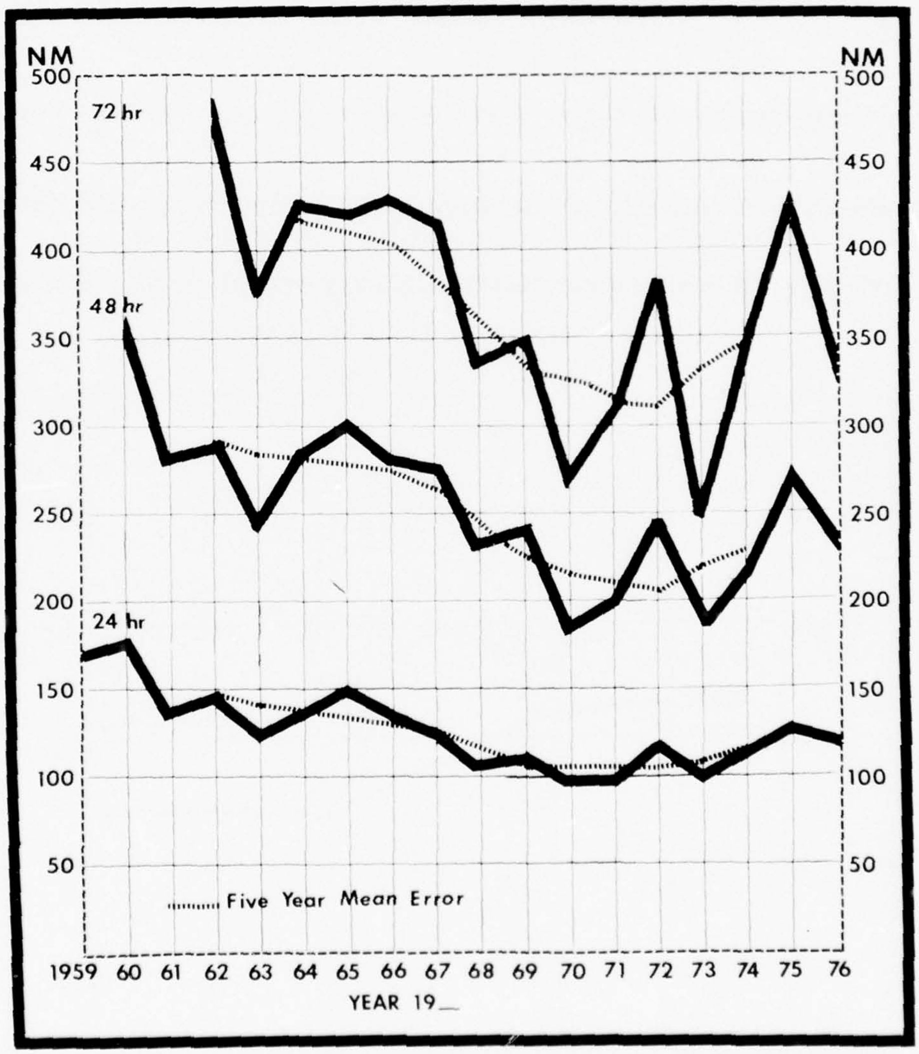


FIGURE 5-1. *Mean vector error for the Pacific Area.*

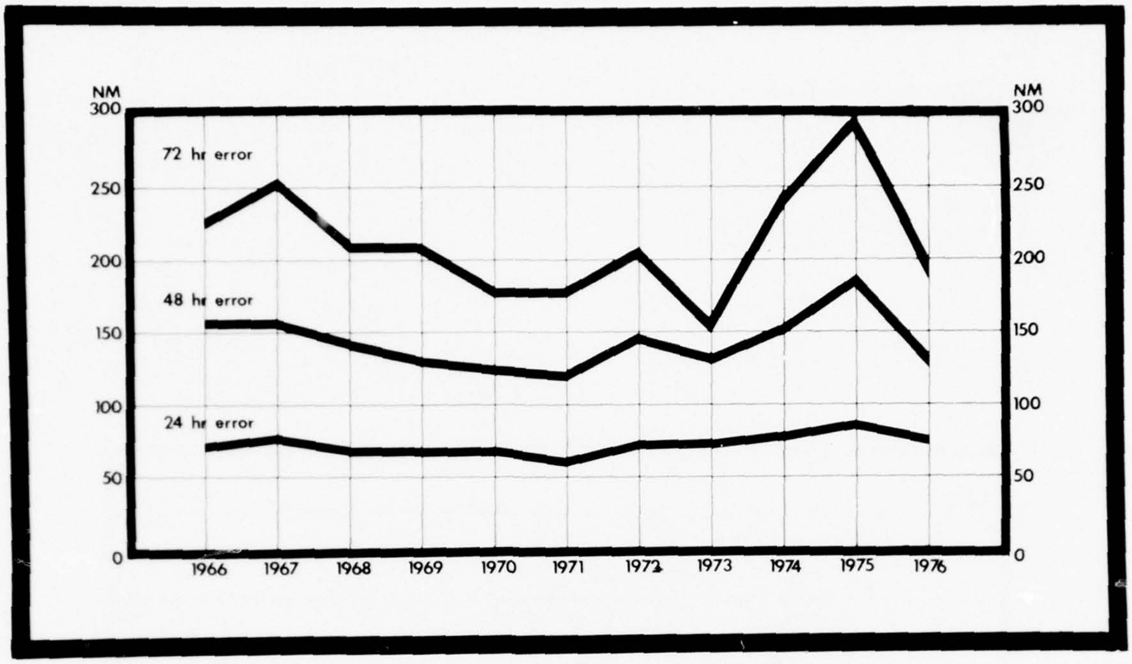


FIGURE 5-2. *Mean right angle error for the Pacific Area.*

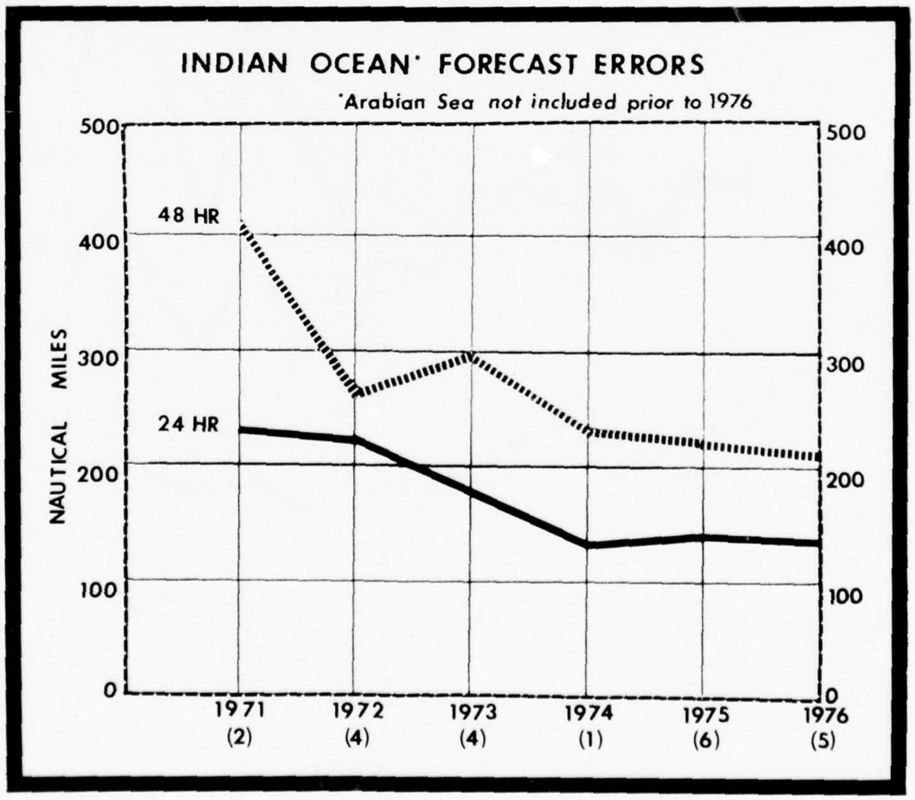


FIGURE 5-3. *Mean vector error for the Indian Ocean Area.*

TABLE 5-5. 1976 OBJECTIVE TECHNIQUES FOR WESTERN NORTH PACIFIC TYPHOONS

24-HOUR

	JTWC	XTRP	HPAC	XT24	TYFC	MH70	MH50
JTWC	390 117 117 0						
XTRP	299 114 127 13	299 127 127 0					
HPAC	271 111 130 19	271 124 130 6	271 130 130 0				
XT24	195 113 131 18	192 125 131 6	182 134 128 -6	195 131 131 0			
TYFC	283 112 129 17	267 125 130 5	245 131 125 -6	182 133 126 -7	283 129 129 0		
MH70	190 115 158 43	185 131 155 24	170 143 154 11	125 139 162	185 138 23 15	190 158 158 0	
MH50	177 114 149 35	172 131 145 14	159 143 143 0	118 135 149 14	172 137 144 7	175 159 149 -10	177 149 149 0

NUMBER OF CASES	X-AXIS TECHNIQUE ERROR
Y-AXIS TECHNIQUE ERROR	ERROR DIFFERENCE Y-X

48-HOUR

	JTWC	XTRP	HPAC	XT24	TYFC	MH70	MH50
JTWC	334 232 232 0						
XTRP	270 233 270 37	270 270 270 0					
HPAC	239 231 244 13	239 277 244 -33	239 244 244 0				
XT24	171 243 298 48	169 291 298 7	164 262 297 35	171 298 298 0			
TYFC	247 236 273 37	231 286 277 -9	215 250 273 23	157 314 275 -39	247 273 273 0		
MH70	157 243 355 112	152 299 353 54	144 270 356 86	103 320 385 65	155 287 349 62	157 355 355 0	
MH50	147 243 310 67	143 289 306 17	138 270 304 34	99 293 342 49	145 287 305 18	145 359 311 -48	147 310 310 0

JTWC-OFFICIAL JTWC SUBJECTIVE FORECAST
XTRP-12-HOUR EXTRAPOLATION
HPAC-MEAN OF XTRP AND CLIMATOLOGY
TYFC-TYFN75 (WEIGHTED CLIMO) COMBINED
MH70-MOHATT 700-MB PROG
MH50-MOHATT 500-MB PROG

72-HOUR

	JTWC	XT24	TYFC	MH70	MH50
JTWC	277 335 335 0				
XT24	130 353 438 85	130 438 438 0			
TYFC	219 346 390 44	125 442 389 -53	219 390 390 0		
MH70	117 369 572 203	73 466 618 152	118 415 562 147	117 572 572 0	
MH50	119 374 523 149	75 450 574 124	119 412 514 102	115 567 522 -45	119 523 523 0

TABLE 5-6. 1976 OBJECTIVE TECHNIQUES FOR ALL WESTERN NORTH PACIFIC FORECASTS

24-HOUR

	JTWC	XTRP	HPAC	XT24	TYFC	MH70	MH50
JTWC	525 117 117 0						
XTRP	414 116 134 18	414 134 134 0					
HPAC	367 114 129 15	366 133 129 -4	367 129 129 0				
XT24	263 114 132 18	259 126 133 7	235 132 131 -1	263 132 132 0			
TYFC	373 113 132 19	352 133 144 11	315 130 127 -3	242 138 125 -13	373 132 132 0		
MH70	251 117 153 36	244 133 151 18	218 139 150 11	168 144 154 10	245 139 150 11	251 153 153 0	
MH50	233 117 150 33	227 134 147 13	205 138 146 8	160 142 151 9	227 138 147 9	231 153 151 -2	233 150 150 0

48-HOUR

	JTWC	XTRP	HPAC	XT24	TYFC	MH70	MH50
JTWC	425 231 231 0						
XTRP	346 231 265 34	346 265 265 0					
HPAC	302 228 249 21	301 269 248 -21	302 249 249 0				
XT24	220 241 287 46	217 282 287 5	203 255 287 32	220 287 287 0			
TYFC	310 235 269 34	287 281 274 -7	262 256 269 13	198 305 264 -41	310 269 269 0		
MH70	198 247 334 87	191 296 333 37	177 263 338 75	135 311 350 39	195 276 329 53	198 334 334 0	
MH50	184 246 300 54	179 274 296 22	169 262 295 33	130 294 317 23	181 275 295 20	183 336 300 -36	184 300 300 0

JTWC-OFFICIAL JTWC SUBJECTIVE FORECAST
XTRP-12-HOUR EXTRAPOLATION
HPAC-MEAN OF XTRP AND CLIMATOLOGY
TYFC-TYFN-TYFN75 (WEIGHTED CLIMO) COMBINED
MH70-MOHATT 700-MB PROG
MH50-MOHATT 500-MB PROG

72-HOUR

	JTWC	XT24	TYFC	MH70	MH50
JTWC	333 338 338 0				
XT24	161 359 417 58	161 417 417 0			
TYFC	258 347 377 30	151 424 369 -55	258 377 377 0		
MH70	142 372 531 159	95 429 556 127	144 390 522 132	142 531 531 0	
MH50	144 377 511 134	97 429 545 116	144 378 496 118	140 526 511 -15	144 511 511 0

3. PACIFIC AREA TROPICAL STORM AND DEPRESSION DATA

TROPICAL STORM LORNA

0600Z 27 FEB TO 0600Z 01 MAR

	BEST TRACK POSIT	BEST TRACK WIND	WARNING POSIT	WARNING WIND	WARNING ERRORS DST	WARNING ERRORS WIND	24 HOUR FORECAST POSIT	24 HOUR FORECAST WIND	24 HOUR ERRORS DST	24 HOUR ERRORS WIND	48 HOUR FORECAST POSIT	48 HOUR FORECAST WIND	48 HOUR ERRORS DST	48 HOUR ERRORS WIND	72 HOUR FORECAST POSIT	72 HOUR FORECAST WIND	72 HOUR ERRORS DST	72 HOUR ERRORS WIND
270600Z	6.1N 151.6E	25	7,9N 151,3E	25	21	0	9,2N 146.0E	40	173	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
271200Z	6.4N 150.8E	25	8,6N 150,5E	25	21	0	9,8N 145.9E	35	118	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
271800Z	6.8N 150.2E	30	8,9N 149,3E	25	53	-5	10,0N 144.9E	35	114	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
280000Z	9.3N 149.5E	30	9,6N 149,5E	30	18	0	11,2N 145.9E	40	133	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
280600Z	9.6N 148.9E	35	10,0N 148,6E	35	30	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
281200Z	9.8N 147.9E	35	10,2N 148,1E	35	27	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
281800Z	9.6N 146.8E	35	10,4N 147,7E	35	71	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
290000Z	9.0N 145.6E	30	10,2N 147,5E	35	133	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

ALL FORECASTS	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	47NM	134NM	0NM	0NM
AVERAGE RIGHT ANGLE ERROR	24NM	54NM	0NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	1KTS	4KTS	0KTS	0KTS
AVERAGE BIAS OF WIND ERROR	0KTS	4KTS	0KTS	0KTS
NUMBER OF FORECASTS	8	4	0	0

TROPICAL STORM NANCY

1200Z 25 APR TO 0000Z 02 MAY

	BEST TRACK POSIT	BEST TRACK WIND	WARNING POSIT	WARNING WIND	WARNING ERRORS DST	WARNING ERRORS WIND	24 HOUR FORECAST POSIT	24 HOUR FORECAST WIND	24 HOUR ERRORS DST	24 HOUR ERRORS WIND	48 HOUR FORECAST POSIT	48 HOUR FORECAST WIND	48 HOUR ERRORS DST	48 HOUR ERRORS WIND	72 HOUR FORECAST POSIT	72 HOUR FORECAST WIND	72 HOUR ERRORS DST	72 HOUR ERRORS WIND
251200Z	11.5N 162.0E	30	11,4N 162,1E	30	8	0	14,8N 160.2E	50	173	15	18.6N 159.5E	55	262	10	22.2N 160.3E	50	489	[illegible]
251800Z	11.8N 160.9E	30	11,4N 161,9E	30	63	0	13,7N 160.4E	50	116	15	16.8N 159.5E	55	170	10	20.2N 159.6E	50	391	[illegible]
260000Z	11.8N 160.0E	30	12,7N 160,1E	30	54	0	15,2N 157.4E	50	136	10	18.8N 157.3E	55	235	10	22.2N 158.6E	50	459	[illegible]
260600Z	11.9N 159.4E	35	12,4N 158,7E	35	76	0	13,3N 154.1E	50	264	10	14.2N 150.2E	60	357	15	15.2N 146.3E	70	461	15
261200Z	12.2N 158.9E	35	12,4N 157,6E	35	77	0	13,0N 153.9E	55	263	10	14.0N 150.1E	65	337	15	15.1N 146.1E	75	433	[illegible]
261800Z	12.7N 158.7E	35	12,2N 158,4E	35	35	0	12,6N 156.4E	55	144	10	13.4N 153.2E	65	166	15	14.4N 149.3E	75	222	[illegible]
270000Z	13.3N 158.7E	40	12,4N 158,7E	35	54	-5	12,7N 157.9E	45	146	0	13.0N 156.3E	55	168	5	13.4N 154.3E	65	201	[illegible]
270600Z	13.9N 158.6E	40	14,8N 158,4E	40	55	0	16,8N 158.5E	60	162	15	19.5N 159.3E	60	372	5	22.3N 161.7E	55	687	[illegible]
271200Z	14.4N 158.2E	45	15,0N 158,5E	40	40	-5	17,0N 158.6E	50	193	0	19.8N 159.1E	50	405	-5	23.0N 161.6E	40	743	[illegible]
271800Z	14.8N 157.4E	45	15,1N 157,7E	45	25	0	17,2N 157.2E	55	157	5	19.9N 156.5E	55	324	0	23.0N 157.0E	45	589	[illegible]
280000Z	14.9N 156.8E	45	15,0N 156,9E	45	8	0	16,1N 155.3E	55	51	5	18.0N 154.7E	55	191	0	20.9N 155.7E	45	528	5
280600Z	15.1N 156.3E	45	15,2N 156,4E	45	8	0	16,5N 155.1E	45	75	-10	18.9N 154.8E	40	253	-15	21.7N 156.3E	35	647	[illegible]
281200Z	15.2N 155.8E	50	15,4N 155,5E	50	21	0	16,4N 153.3E	50	56	-5	18.3N 151.8E	40	139	-10	20.7N 151.8E	35	466	5
281800Z	15.3N 155.3E	50	15,5N 155,3E	50	12	0	16,3N 153.3E	50	43	-5	18.2N 151.9E	40	188	-5	20.5N 151.8E	35	531	5
290000Z	15.4N 154.8E	50	15,2N 154,8E	50	12	0	15,5N 152.9E	55	55	0	15.9N 150.4E	55	150	15	16.4N 148.0E	55	292	[illegible]
290600Z	15.5N 154.3E	55	15,3N 154,3E	50	12	-5	15,7N 152.2E	55	63	0	16.0N 149.8E	55	190	20	--.- ---.-	--	--	--
291200Z	15.5N 153.6E	55	15,4N 154,0E	50	24	-5	15,6N 151.9E	60	98	10	15.8N 149.4E	60	230	30	--.- ---.-	--	--	--
291800Z	15.7N 152.9E	55	15,6N 152,9E	50	6	-5	15,8N 150.4E	60	78	15	16.1N 147.5E	60	192	30	--.- ---.-	--	--	--
300000Z	16.0N 152.1E	55	15,7N 152,1E	50	18	-5	15,9N 149.0E	60	71	20	16.1N 146.1E	60	184	35	--.- ---.-	--	--	--
300600Z	16.3N 151.3E	55	15,8N 151,3E	55	30	0	15,9N 148.2E	65	98	30	--.- ---.-	--	--	--	--.- ---.-	--	--	--
301200Z	16.4N 150.4E	50	16,3N 150,6E	55	13	5	16,8N 147.5E	65	134	35	--.- ---.-	--	--	--	--.- ---.-	--	--	--
301800Z	16.4N 149.2E	45	16,2N 149,3E	55	13	10	16,8N 145.9E	60	133	30	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010000Z	16.2N 147.8E	40	16,2N 147,3E	45	29	5	15,8N 141.8E	35	100	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010600Z	16.1N 146.5E	35	16,2N 146,3E	40	13	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
011200Z	15.8N 145.4E	30	16,1N 145,2E	40	21	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
011800Z	15.2N 144.3E	30	16,0N 144,3E	35	48	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
020000Z	14.8N 143.2E	25	14,8N 143,5E	25	17	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

ALL FORECASTS	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	29NM	122NM	237NM	475NM
AVERAGE RIGHT ANGLE ERROR	19NM	74NM	147NM	292NM
AVERAGE MAGNITUDE OF WIND ERROR	3KTS	12KTS	13KTS	8KTS
AVERAGE BIAS OF WIND ERROR	0KTS	10KTS	9KTS	7KTS
NUMBER OF FORECASTS	27	23	19	15

TROPICAL STORM VIOLET

0000Z 21 JUL TO 1800Z 25 JUL

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
210000Z	15.9N 115.7E	30	15.7N 115.4E	30	21	0	17.3N 113.8E	35	49	-10	18.8N 112.0E	45	51	-5	20.3N 110.2E	35	85	-5
210600Z	16.5N 115.2E	30	16.3N 115.3E	30	13	0	18.0N 113.5E	40	34	-10	19.6N 111.8E	45	78	-5	21.5N 110.2E	35	137	-5
211200Z	17.2N 114.6E	35	17.1N 114.7E	30	8	-5	19.2N 112.9E	40	67	-15	21.7N 112.1E	50	191	5	23.4N 112.0E	20	215	-20
211800Z	17.7N 114.2E	40	17.7N 114.2E	35	0	-5	19.8N 112.6E	45	106	-10	22.1N 112.0E	45	201	0	24.0N 112.0E	20	228	-20
220000Z	18.1N 113.6E	45	18.2N 113.7E	45	8	0	20.2N 112.3E	60	124	10	22.1N 112.0E	55	188	15	24.0N 112.2E	20	213	-25
220600Z	18.3N 113.0E	50	18.8N 113.1E	50	30	0	21.4N 111.7E	60	173	10	23.4N 111.2E	20	233	-20	--.- ---.-	--	--	--
221200Z	18.3N 112.2E	55	18.7N 111.7E	55	37	0	20.3N 109.2E	40	135	-5	21.9N 108.0E	20	251	-20	--.- ---.-	--	--	--
221800Z	18.3N 111.6E	55	18.9N 110.9E	55	53	0	20.8N 109.0E	40	156	-5	22.7N 107.9E	20	291	-20	--.- ---.-	--	--	--
230000Z	18.4N 111.2E	50	19.1N 110.6E	50	54	0	20.5N 108.7E	40	154	0	22.4N 107.4E	30	326	-15	--.- ---.-	--	--	--
230600Z	18.6N 110.9E	50	18.9N 111.1E	50	21	0	20.4N 108.9E	35	150	-5	22.3N 107.6E	25	319	-25	--.- ---.-	--	--	--
231200Z	18.7N 110.9E	45	19.4N 110.7E	50	42	5	20.4N 109.6E	35	134	-5	22.2N 108.5E	20	241	-35	--.- ---.-	--	--	--
231800Z	18.9N 110.9E	45	19.6N 110.6E	45	45	0	20.9N 109.2E	35	184	-5	22.7N 108.3E	20	208	-30	--.- ---.-	--	--	--
240000Z	19.1N 111.0E	40	19.5N 110.9E	40	25	0	21.2N 110.0E	30	167	-15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240600Z	19.5N 111.4E	40	19.8N 110.9E	40	33	0	21.6N 109.1E	30	230	-20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
241200Z	19.8N 111.9E	40	20.3N 110.9E	35	64	-5	22.4N 110.9E	25	116	-30	--.- ---.-	--	--	--	--.- ---.-	--	--	--
241800Z	20.2N 112.4E	40	20.9N 110.8E	35	99	-5	22.9N 110.9E	25	91	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
250000Z	20.5N 112.9E	45	20.8N 112.8E	40	19	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
250600Z	21.1N 113.2E	50	21.2N 113.3E	45	8	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
251200Z	21.6N 112.8E	55	21.8N 113.2E	55	25	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
251800Z	21.7N 111.9E	50	22.3N 112.8E	50	61	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

ALL FORECASTS

	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	33NM	129NM	215NM	175NM
AVERAGE RIGHT ANGLE ERROR	23NM	103NM	136NM	110NM
AVERAGE MAGNITUDE OF WIND ERROR	2KTS	11KTS	16KTS	15KTS
AVERAGE BIAS OF WIND ERROR	-1KTS	-9KTS	-13KTS	-15KTS
NUMBER OF FORECASTS	20	16	12	5

TROPICAL STORM WILDA

0600Z 22JUL TO 0600Z 24 JUL

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
220600Z	20.5N 138.1E	30	20.3N 137.5E	25	36	-5	22.6N 135.8E	35	287	-10	24.9N 134.1E	45	576	30	--.- ---.-	--	--	--
221200Z	22.2N 138.3E	30	21.4N 137.2E	30	77	0	25.3N 135.8E	45	261	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
221800Z	23.9N 138.3E	35	22.2N 136.8E	35	131	0	25.8N 135.2E	45	378	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
230000Z	25.6N 137.4E	40	27.6N 135.4E	50	160	10	32.7N 128.9E	40	159	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
230600Z	27.4N 135.7E	45	28.2N 135.0E	50	60	5	34.4N 125.9E	40	281	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231200Z	29.4N 134.1E	40	30.0N 133.2E	35	59	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231800Z	31.8N 132.9E	35	31.0N 131.5E	35	86	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240000Z	33.8N 131.8E	25	33.9N 131.5E	35	16	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240600Z	34.3N 131.6E	15	34.2N 131.2E	20	21	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

ALL FORECASTS

	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	72NM	273NM	576NM	0NM
AVERAGE RIGHT ANGLE ERROR	39NM	148NM	161NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	4KTS	13KTS	30KTS	0KTS
AVERAGE BIAS OF WIND ERROR	2KTS	9KTS	30KTS	0KTS
NUMBER OF FORECASTS	9	5	1	0

TROPICAL STORM CLARA

1200Z 05 AUG TO 0000Z 07 AUG

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
051200Z	19.9N 114.2E	30	20.1N 114.1E	30	13	0	21.7N 113.7E	40	35	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
051800Z	20.2N 114.1E	35	20.3N 114.1E	40	6	5	21.9N 114.0E	55	106	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
060000Z	20.5N 114.0E	40	20.5N 114.0E	40	0	0	21.8N 113.8E	55	164	30	--.- ---.-	--	--	--	--.- ---.-	--	--	--
060600Z	20.9N 113.7E	40	21.2N 113.9E	40	21	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
061200Z	21.5N 113.1E	40	21.5N 113.5E	40	22	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
061800Z	22.1N 112.1E	30	22.2N 112.4E	40	28	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
070000Z	22.7N 111.0E	25	22.6N 111.3E	25	18	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

ALL FORECASTS

	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	15NM	102NM	0NM	0NM
AVERAGE RIGHT ANGLE ERROR	8NM	40NM	0NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	2KTS	18KTS	0KTS	0KTS
AVERAGE BIAS OF WIND ERROR	2KTS	18KTS	0KTS	0KTS
NUMBER OF FORECASTS	7	3	0	0

TROPICAL STORM DOT

1800Z 18 AUG TO 0000Z 23 AUG

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
181800Z	22.4N 134.9E	30	22.5N 134.9E	30	6	0	24.4N 129.6E	55	48	5	25.8N 125.3E	65	128	25	26.7N 121.2E	70	267	35
190000Z	22.9N 133.3E	35	23.0N 133.4E	35	8	0	24.9N 128.3E	55	48	5	26.2N 124.2E	65	147	25	26.9N 120.0E	70	327	35
190600Z	23.6N 131.8E	40	23.3N 132.3E	40	33	0	24.7N 127.4E	60	110	10	25.8N 123.0E	70	216	30	27.0N 118.9E	45	411	15
191200Z	24.4N 130.4E	45	23.5N 131.8E	45	93	0	24.8N 127.6E	60	184	15	25.8N 123.5E	70	270	30	26.4N 119.2E	45	512	15
191800Z	25.0N 129.0E	50	25.0N 129.0E	45	0	-5	27.9N 120.9E	65	165	25	28.1N 116.8E	30	328	-5	--.- ---.-	--	--	--
200000Z	25.5N 127.7E	50	25.6N 127.7E	50	6	0	27.5N 122.8E	40	63	0	29.4N 119.5E	25	212	-10	--.- ---.-	--	--	--
200600Z	26.3N 126.4E	50	26.2N 126.5E	45	8	-5	28.7N 122.0E	35	56	-5	30.5N 119.6E	25	221	-5	--.- ---.-	--	--	--
201200Z	26.8N 125.0E	45	26.8N 125.1E	45	5	0	29.6N 120.9E	30	81	-10	31.5N 120.2E	25	239	-5	--.- ---.-	--	--	--
201800Z	27.6N 124.0E	40	27.5N 123.9E	45	8	5	30.6N 120.4E	25	92	-10	32.4N 120.3E	20	336	-10	--.- ---.-	--	--	--
210000Z	28.5N 123.2E	40	28.1N 122.9E	40	29	0	30.6N 120.5E	25	124	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
210600Z	29.4N 122.7E	40	29.1N 122.6E	40	19	0	32.5N 122.2E	30	42	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
211200Z	30.2N 122.3E	40	30.0N 122.3E	40	12	0	32.9N 122.8E	30	85	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
211800Z	31.1N 122.1E	35	30.9N 122.7E	40	13	5	34.0N 123.6E	30	146	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
220000Z	32.0N 122.3E	35	31.6N 122.3E	35	24	0	34.6N 124.3E	30	217	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
220600Z	33.0N 122.8E	30	32.5N 122.5E	30	33	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
221200Z	33.9N 124.0E	30	33.4N 122.9E	30	62	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
221800Z	35.0N 126.3E	30	34.3N 123.9E	30	125	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
230000Z	35.8N 128.5E	20	35.7N 128.9E	25	20	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	28NM	104NM	233NM	379NM
AVERAGE RIGHT ANGLE ERROR	9NM	48NM	123NM	208NM
AVERAGE MAGNITUDE OF WIND ERROR	1KTS	8KTS	16KTS	25KTS
AVERAGE BIAS OF WIND ERROR	0KTS	3KTS	8KTS	25KTS
NUMBER OF FORECASTS	18	14	9	4

TROPICAL STORM ELLEN

1800Z 20 AUG TO 0600Z 24 AUG

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
201800Z	14.4N 131.9E	30	14.6N 131.6E	30	21	0	16.6N 127.4E	50	93	15	18.5N 123.9E	65	233	30	20.5N 120.6E	80	292	35
210000Z	15.0N 130.5E	35	15.1N 130.5E	35	6	0	17.4N 125.9E	50	103	15	19.5N 122.3E	70	197	30	21.4N 119.1E	85	271	60
210600Z	15.8N 129.1E	35	15.6N 129.7E	35	13	0	17.9N 124.2E	45	110	10	20.1N 120.2E	60	136	15	--.- ---.-	--	--	--
211200Z	16.5N 127.4E	35	16.5N 128.0E	35	34	0	19.0N 122.9E	50	123	15	21.3N 118.9E	65	103	20	--.- ---.-	--	--	--
211800Z	16.9N 125.8E	35	17.1N 126.7E	35	53	0	19.6N 121.8E	45	120	10	21.9N 117.8E	60	116	15	--.- ---.-	--	--	--
220000Z	17.2N 124.1E	35	17.3N 124.0E	35	8	0	19.7N 119.0E	50	13	10	22.2N 114.9E	55	62	30	--.- ---.-	--	--	--
220600Z	17.6N 122.3E	35	18.0N 122.4E	35	25	0	20.3N 117.7E	50	8	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
221200Z	18.2N 120.9E	35	18.1N 121.7E	35	46	0	19.7N 117.2E	40	120	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
221800Z	18.9N 119.8E	35	18.6N 120.3E	35	33	0	20.3N 115.9E	45	132	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
230000Z	19.6N 118.8E	40	19.3N 119.1E	35	25	-5	22.0N 114.3E	55	74	30	--.- ---.-	--	--	--	--.- ---.-	--	--	--
230600Z	20.4N 117.8E	45	20.1N 117.1E	45	43	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231200Z	21.7N 117.1E	45	20.5N 116.4E	50	82	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231800Z	22.5N 115.8E	45	21.5N 115.9E	50	60	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240000Z	23.2N 114.6E	25	22.3N 114.9E	50	56	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	36NM	89NM	141NM	282NM
AVERAGE RIGHT ANGLE ERROR	23NM	50NM	69NM	99NM
AVERAGE MAGNITUDE OF WIND ERROR	3KTS	12KTS	23KTS	48KTS
AVERAGE BIAS OF WIND ERROR	2KTS	11KTS	23KTS	48KTS
NUMBER OF FORECASTS	14	10	6	2

TROPICAL STORM GEORGIA

0000Z 09 SEP TO 0000Z 15 SEP

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
090000Z	9.1N 156.5E	30	9.2N 156.5E	30	6	0	11.9N 151.3E	50	135	10	13.9N 146.8E	70	250	30	15.8N 142.2E	90	295	55
090600Z	9.6N 155.4E	30	9.5N 156.2E	40	47	10	11.1N 152.5E	60	64	20	13.1N 146.0E	80	112	40	15.1N 143.6E	100	183	65
091200Z	9.9N 154.5E	35	9.9N 153.5E	40	59	5	11.4N 147.6E	60	236	20	12.9N 142.7E	80	298	40	14.4N 138.1E	100	336	65
091800Z	10.0N 153.6E	35	10.1N 153.6E	45	6	10	11.4N 148.9E	65	116	25	13.2N 144.4E	85	152	50	14.6N 139.7E	105	204	70
100000Z	10.1N 152.7E	40	10.2N 152.5E	45	13	5	11.8N 147.9E	65	124	25	13.4N 143.3E	85	163	50	15.5N 139.0E	105	220	70
100600Z	10.1N 152.1E	40	10.2N 152.2E	45	8	5	11.5N 148.4E	65	24	25	13.2N 143.9E	85	72	50	15.2N 139.7E	105	141	75
101200Z	10.1N 151.4E	40	10.5N 150.9E	50	38	10	11.9N 147.0E	70	41	30	13.8N 142.5E	90	102	55	15.8N 138.0E	110	249	85
101800Z	10.4N 150.6E	40	9.8N 150.9E	40	40	0	11.0N 146.9E	50	72	15	12.9N 142.4E	60	24	25	--.-	---.-	--	--	--
110000Z	10.9N 149.8E	40	10.1N 149.2E	40	48	0	11.3N 145.9E	45	66	10	13.3N 141.4E	55	48	20	--.- ---.-	--	--	--
110600Z	11.4N 148.8E	40	11.3N 149.0E	40	13	0	12.3N 145.2E	45	36	10	13.6N 141.4E	55	33	25	--.- ---.-	--	--	--
111200Z	11.9N 147.7E	40	11.7N 147.9E	40	13	0	13.2N 143.5E	45	48	10	14.9N 139.0E	55	181	30	--.- ---.-	--	--	--
111800Z	12.2N 146.8E	35	12.1N 146.8E	40	6	5	13.6N 142.2E	45	50	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
120000Z	12.4N 145.9E	35	12.5N 146.1E	40	13	5	14.1N 142.0E	40	38	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
120600Z	12.2N 144.6E	35	12.8N 145.1E	40	46	5	14.3N 141.0E	40	50	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
121200Z	12.4N 143.5E	35	12.8N 143.8E	40	30	5	14.4N 139.7E	50	139	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
121800Z	13.0N 142.8E	35	12.9N 143.5E	40	41	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
130000Z	13.5N 142.2E	35	13.9N 142.6E	40	33	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
130600Z	14.0N 141.8E	30	14.5N 141.9E	35	30	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
131200Z	14.5N 142.1E	25	14.7N 141.3E	35	48	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	28NM	83NM	130NM	232NM
AVERAGE RIGHT ANGLE ERROR	16NM	38NM	56NM	153NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	17KTS	38KTS	69KTS
AVERAGE BIAS OF WIND ERROR	5KTS	17KTS	38KTS	69KTS
NUMBER OF FORECASTS	19	15	11	7

TROPICAL STORM MARGE

0000Z 06 NOV TO 0000Z 11 NOV

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
060000Z	10.9N 140.1E	25	10.3N 141.2E	25	74	0	13.2N 136.7E	35	157	5	15.7N 133.1E	45	287	5	18.6N 130.8E	60	313	0
060600Z	11.9N 137.5E	25	11.1N 140.1E	25	160	0	14.3N 135.6E	35	150	5	16.6N 132.4E	50	283	5	19.0N 131.0E	65	355	5
061200Z	13.3N 135.3E	25	12.1N 139.2E	25	227	0	15.2N 135.0E	35	214	5	18.4N 132.8E	45	335	-10	21.2N 132.9E	55	442	-5
061800Z	12.9N 134.7E	25	11.4N 134.7E	25	84	0	15.4N 131.2E	35	104	0	19.4N 129.9E	45	203	-15	22.2N 130.3E	55	316	0
070000Z	13.9N 134.1E	30	12.8N 133.9E	25	68	-5	17.2N 130.5E	40	126	0	20.1N 129.3E	55	205	-5	23.0N 130.6E	55	322	5
070600Z	15.0N 133.1E	30	14.3N 133.1E	25	42	-5	18.1N 129.7E	40	121	-5	21.0N 128.3E	55	171	-5	24.5N 130.8E	50	275	5
071200Z	15.5N 131.3E	30	15.5N 133.7E	30	109	0	19.3N 129.0E	40	124	-15	22.4N 128.9E	50	211	-10	26.4N 133.6E	50	350	15
071800Z	16.2N 129.6E	35	16.6N 129.8E	30	26	-5	20.0N 126.0E	45	29	-15	24.4N 129.9E	50	273	-5	29.3N 139.3E	45	577	20
080000Z	17.1N 128.3E	40	18.1N 128.2E	30	60	-10	23.1N 127.7E	45	181	-15	26.8N 134.2E	35	492	-15	32.3N 145.3E	30	794	5
080600Z	17.8N 127.6E	45	18.3N 127.5E	45	30	0	22.9N 127.7E	60	154	0	26.8N 134.2E	55	434	10	--.- ---.-	--	--	--
081200Z	18.7N 126.9E	55	19.0N 126.9E	55	18	0	23.8N 127.9E	60	165	0	28.2N 135.2E	50	432	15	--.- ---.-	--	--	--
081800Z	19.6N 126.3E	60	19.9N 126.2E	60	19	0	24.7N 128.5E	50	200	-5	28.9N 136.7E	40	440	15	--.- ---.-	--	--	--
090000Z	20.7N 125.7E	60	20.6N 125.8E	55	8	-5	25.2N 124.9E	50	16	0	30.2N 131.9E	40	132	15	--.- ---.-	--	--	--
090600Z	21.6N 125.3E	60	21.7N 125.1E	65	13	5	26.9N 126.3E	65	37	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
091200Z	22.8N 125.1E	60	22.4N 125.1E	60	24	0	27.1N 127.6E	50	27	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
091800Z	24.0N 124.9E	55	23.9N 124.7E	45	12	-10	28.5N 127.3E	30	71	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
100000Z	25.2N 125.2E	50	25.2N 125.1E	35	5	-15	29.8N 127.5E	30	165	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
100600Z	26.3N 126.1E	45	25.6N 125.6E	35	50	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
101200Z	27.2N 127.1E	35	26.8N 126.9E	35	26	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
101800Z	27.9N 128.4E	25	27.9N 129.2E	30	42	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
110000Z	28.3N 130.6E	25	28.5N 131.2E	30	34	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	54NM	120NM	300NM	416NM
AVERAGE RIGHT ANGLE ERROR	27NM	76NM	178NM	327NM
AVERAGE MAGNITUDE OF WIND ERROR	4KTS	7KTS	10KTS	7KTS
AVERAGE BIAS OF WIND ERROR	-2KTS	0KTS	0KTS	6KTS
NUMBER OF FORECASTS	21	17	13	9

TROPICAL STORM NORA

0000Z 03 DEC TO 0000Z 08 DEC

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
030000Z	12.3N 127.4E	30	12.1N 127.5E	30	13	0	13.2N 124.5E	40	113	0	14.0N 122.6E	45	129	5	14.8N 120.8E	35	193	0
030600Z	12.3N 127.1E	30	11.8N 127.1E	30	30	0	12.5N 125.1E	40	41	-5	13.5N 123.3E	40	72	0	14.4N 121.4E	35	121	0
031200Z	12.4N 126.9E	30	13.1N 125.9E	30	72	0	14.3N 122.9E	45	172	0	15.2N 120.2E	30	259	-10	15.9N 118.3E	35	310	5
031800Z	12.4N 126.6E	35	12.3N 127.1E	35	30	0	13.1N 124.9E	50	38	10	14.2N 122.3E	45	117	5	15.0N 120.0E	35	193	10
040000Z	12.5N 126.3E	40	12.4N 126.6E	40	18	0	13.4N 124.7E	45	69	5	15.3N 122.1E	45	169	10	16.3N 119.8E	45	238	25
040600Z	12.6N 125.8E	45	12.8N 125.9E	45	13	0	14.3N 123.5E	55	115	15	16.2N 121.5E	45	208	10	17.7N 120.0E	35	282	15
041200Z	12.6N 125.3E	45	12.8N 125.4E	50	21	5	13.5N 123.7E	55	66	15	14.6N 121.5E	45	113	15	15.5N 119.8E	30	226	10
041800Z	12.5N 124.7E	40	12.4N 124.5E	50	13	10	12.5N 121.2E	40	122	0	12.5N 118.8E	35	262	10	12.5N 117.3E	35	403	15
050000Z	12.4N 124.1E	40	12.4N 124.2E	40	6	0	13.0N 122.0E	30	63	-5	13.7N 120.5E	35	165	15	13.9N 119.2E	35	237	15
050600Z	12.4N 123.6E	40	12.8N 123.5E	40	30	0	13.5N 121.4E	30	92	-5	13.8N 119.6E	30	211	10	--.-	--- .-	--	--	--
051200Z	12.4N 123.6E	40	12.9N 123.4E	40	27	0	13.2N 121.7E	35	77	5	13.5N 119.9E	35	224	15	--.-	---.-	--	--	--
051800Z	12.5N 123.3E	40	12.9N 122.9E	40	33	0	13.5N 121.4E	35	100	10	13.8N 119.7E	35	246	15	--.- ---.-	--	--	--
060000Z	12.6N 123.0E	35	12.8N 123.0E	40	12	5	12.9N 122.1E	30	104	10	13.6N 120.6E	30	216	10	--.- ---.-	--	--	--
060600Z	13.0N 122.9E	35	13.0N 122.8E	35	6	0	13.3N 122.1E	30	96	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
061200Z	13.4N 123.0E	30	13.3N 123.1E	35	6	5	13.7N 121.8E	25	117	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
061800Z	13.8N 123.1E	25	13.7N 123.1E	35	6	10	13.9N 121.9E	25	125	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
070000Z	14.2N 123.3E	20	13.8N 122.9E	30	33	10	13.9N 122.4E	25	117	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
070600Z	14.3N 123.4E	20	14.2N 123.2E	25	13	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
071200Z	14.6N 123.6E	20	14.3N 123.6E	25	18	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
071800Z	14.9N 123.8E	20	14.5N 123.8E	25	24	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
080000Z	15.1N 124.0E	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	21NM	96NM	184NM	249NM
AVERAGE RIGHT ANGLE ERROR	10NM	63NM	132NM	225NM
AVERAGE MAGNITUDE OF WIND ERROR	3KTS	6KTS	10KTS	11KTS
AVERAGE BIAS OF WIND ERROR	3KTS	5KTS	8KTS	11KTS
NUMBER OF FORECASTS	20	17	13	9

TROPICAL STORM OPAL

0000Z 09 DEC TO 1200Z 10 DEC

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
090000Z	18.2N 134.5E	35	18.3N 134.4E	35	8	0	21.2N 137.3E	40	126	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
090600Z	18.8N 135.1E	35	18.7N 134.9E	40	18	5	21.6N 137.8E	45	158	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
091200Z	19.4N 135.9E	30	19.5N 135.9E	40	8	10	22.9N 139.7E	40	198	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
091800Z	19.3N 136.9E	25	20.1N 136.3E	40	58	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
100000Z	19.2N 138.0E	20	19.3N 138.1E	35	6	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
100600Z	19.2N 139.0E	20	19.5N 139.1E	35	18	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
101200Z	19.6N 140.0E	20	19.7N 139.9E	30	8	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	18NM	161NM	0NM	0NM
AVERAGE RIGHT ANGLE ERROR	14NM	152NM	0NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	10KTS	22KTS	0KTS	0KTS
AVERAGE BIAS OF WIND ERROR	10KTS	22KTS	0KTS	0KTS
NUMBER OF FORECASTS	7	3	0	0

4. PACIFIC AREA TYPHOON DATA

TYPHOON KATHY

0000Z 28 JAN TO 0600Z 02 FEB

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
280000Z	5.7N 147.8E	35	5,8N 147,7E	30	8	-5	8,6N 145,0E	45	110	5	11.2N 142.1E	60	182	5	12,8N 138.7E	70	97	-5
280600Z	6.3N 146.7E	35	5,9N 147,1E	35	34	0	8,3N 143,9E	55	96	15	10.6N 140.7E	70	128	5	12,0N 136.9E	85	242	5
281200Z	6.8N 145.7E	40	8,1N 145,2E	40	63	0	11,6N 140,6E	60	176	15	13.8N 136.0E	75	164	10	14,2N 132.1E	85	446	10
281800Z	7.2N 144.6E	40	8,1N 144,1E	40	61	0	11,5N 139,4E	55	119	5	13.1N 134.9E	70	198	0	13,4N 131.0E	80	583	10
290000Z	7.5N 143.5E	40	7,5N 143,0E	40	30	0	8,8N 138,0E	45	115	-10	9.9N 133.0E	55	414	-20	10,7N 129.2E	65	851	0
290600Z	8.0N 142.3E	40	7,5N 143,2E	45	61	5	8,5N 140,4E	50	193	-15	9.5N 137.3E	55	375	-25	10,3N 134.2E	65	735	5
291200Z	8.7N 141.1E	45	7,6N 142,4E	45	101	0	8,6N 139,3E	50	223	-15	9.4N 136.1E	55	476	-20	9,9N 132.9E	65	939	10
291800Z	9.6N 140.0E	50	9,1N 139,6E	40	38	-10	10,6N 136,5E	45	188	-25	11.4N 133.4E	50	540	-20	--.-	---.-	--	--	--
300000Z	10.4N 139.1E	55	10,1N 139,5E	45	30	-10	12,0N 136,8E	50	171	-25	13.8N 134.2E	55	506	-10	--.-	---.-	--	--	--
300600Z	11.2N 138.6E	65	10,7N 138,7E	65	30	0	13,4N 136,5E	85	187	5	15.7N 135.1E	80	515	20	--.-	---.-	--	--	--
301200Z	12.2N 138.3E	65	12,0N 138,1E	70	17	5	15,8N 138,0E	70	97	-5	19.5N 143.0E	65	158	10	--.-	---.-	--	--	--
301800Z	13.2N 138.3E	70	13,2N 138,2E	70	6	0	17,6N 141,0E	60	52	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
310000Z	14.4N 138.4E	75	14,5N 138,3E	70	8	-5	19,0N 141,5E	55	36	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
310600Z	15.6N 138.8E	80	15,6N 138,9E	80	6	0	19,6N 142,5E	55	86	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
311200Z	16.7N 139.4E	75	16,4N 139,2E	75	21	0	20,0N 142,6E	55	182	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
311800Z	17.7N 140.1E	70	17,3N 139,8E	70	29	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010000Z	18.4N 141.6E	65	18,4N 140,8E	70	45	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010600Z	18.6N 143.6E	60	19,0N 143,0E	65	41	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
011200Z	19.5N 145.8E	55	20,0N 146,1E	60	34	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	36NM	135NM	332NM	556NM	36NM	135NM	332NM	556NM
AVERAGE RIGHT ANGLE ERROR	18NM	75NM	180NM	291NM	18NM	75NM	180NM	291NM
AVERAGE MAGNITUDE OF WIND ERROR	3KTS	11KTS	13KTS	6KTS	3KTS	11KTS	13KTS	6KTS
AVERAGE BIAS OF WIND ERROR	-0KTS	-5KTS	-4KTS	5KTS	-0KTS	-5KTS	-4KTS	5KTS
NUMBER OF FORECASTS	19	15	11	7	19	15	11	7

TYPHOON MARIE

0600Z 03 APR TO 0000Z 14 APR

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
030600Z	8.2N 140.4E	30	8.3N 140.1E	30	19	0	8.5N 138.8E	40	112	-5	9.3N 137.1E	50	177	-15	10.4N 135.4E	50	206	-15
031200Z	8.1N 140.7E	35	8.5N 140.8E	35	25	0	9.6N 140.0E	40	78	-10	10.7N 139.5E	50	204	-15	11.8N 138.8E	60	248	-5
031800Z	8.2N 140.9E	40	8.8N 140.4E	35	46	-5	9.9N 139.9E	45	132	-10	10.8N 139.3E	50	217	-15	11.8N 138.7E	60	251	-5
040000Z	8.3N 141.0E	40	8.1N 141.2E	40	17	0	8.9N 141.2E	55	126	-5	9.9N 140.5E	60	202	-5	10.9N 139.8E	60	271	-5
040600Z	8.6N 140.7E	45	8.3N 141.1E	45	30	0	9.2N 140.9E	60	139	-5	10.2N 140.3E	65	210	0	11.2N 139.5E	65	288	0
041200Z	8.3N 140.0E	50	8.5N 140.9E	45	55	-5	9.5N 140.6E	60	155	-5	10.6N 140.1E	65	235	0	11.6N 139.7E	65	344	-5
041800Z	7.7N 139.8E	55	8.1N 140.0E	45	27	-10	9.2N 139.6E	60	128	-5	10.2N 139.3E	65	204	0	11.3N 139.0E	65	335	-10
050000Z	7.5N 139.6E	60	7.8N 139.5E	55	19	-5	8.5N 138.9E	70	78	5	9.6N 138.5E	75	164	10	11.5N 137.8E	80	320	0
050600Z	7.4N 139.4E	65	7.3N 139.2E	65	13	0	7.5N 137.9E	75	21	10	8.5N 135.7E	80	13	15	10.2N 133.0E	80	93	0
051200Z	7.3N 139.2E	65	7.2N 139.3E	70	8	5	7.2N 138.5E	80	96	15	7.8N 136.6E	85	105	15	9.6N 133.9E	85	120	0
051800Z	7.2N 138.8E	65	7.2N 139.1E	70	18	5	7.2N 138.3E	80	122	15	7.9N 136.4E	85	132	10	9.7N 133.8E	85	139	0
060000Z	7.4N 138.2E	65	7.4N 138.5E	70	18	5	8.1N 137.1E	65	59	0	9.1N 135.4E	60	129	-20	9.8N 132.1E	50	53	-40
060600Z	7.8N 137.7E	65	7.8N 137.9E	65	12	0	8.6N 135.9E	60	25	-5	10.1N 132.9E	50	85	-30	10.5N 129.3E	45	100	-50
061200Z	8.0N 137.1E	65	8.0N 137.4E	65	18	0	9.1N 135.2E	60	51	-10	10.4N 132.2E	50	90	-35	11.0N 128.6E	45	112	-55
061800Z	8.2N 136.5E	65	8.2N 136.5E	65	0	0	9.3N 133.9E	65	62	-10	10.2N 130.9E	60	69	-25	10.3N 127.3E	60	174	-40
070000Z	8.2N 136.1E	65	8.4N 136.1E	65	12	0	9.7N 133.7E	65	75	-15	10.8N 130.6E	60	75	-30	11.5N 127.0E	60	150	-45
070600Z	8.3N 135.6E	65	8.3N 135.8E	65	12	0	8.7N 133.7E	65	65	-15	9.8N 130.8E	60	38	-35	11.0N 127.9E	60	144	-45
071200Z	8.3N 134.9E	70	8.3N 135.2E	65	18	-5	8.6N 133.0E	65	62	-20	9.6N 129.8E	60	99	-40	10.9N 126.4E	60	223	-50
071800Z	8.3N 134.2E	75	8.3N 134.3E	70	6	-5	8.9N 131.3E	70	21	-15	10.1N 127.9E	65	151	-35	11.0N 125.3E	60	284	-55
080000Z	8.5N 133.3E	80	8.4N 133.3E	80	6	0	8.6N 130.1E	85	92	-5	9.5N 126.5E	75	243	-30	10.7N 123.1E	60	427	-55
080600Z	8.7N 132.6E	80	8.6N 132.5E	80	8	0	8.9N 129.5E	95	126	0	9.5N 126.7E	90	257	-15	10.5N 123.5E	60	458	-55
081200Z	8.9N 132.0E	85	8.7N 131.7E	85	21	0	9.1N 128.6E	95	164	-5	9.7N 125.9E	90	298	-20	10.8N 122.8E	60	528	-55
081800Z	9.2N 131.5E	85	8.9N 131.3E	85	21	0	9.5N 128.4E	95	158	-5	10.2N 125.7E	85	306	-30	11.4N 122.7E	60	573	-50
090000Z	9.7N 131.2E	90	9.1N 130.6E	90	50	0	9.7N 127.8E	100	187	-5	10.6N 125.0E	90	353	-25	12.0N 121.6E	60	663	-45
090600Z	10.4N 131.0E	95	10.4N 130.6E	90	23	-5	12.5N 128.5E	100	50	-5	13.6N 125.6E	90	243	-25	14.3N 122.2E	80	624	-20
091200Z	11.1N 130.5E	100	11.1N 130.7E	95	12	-5	13.5N 129.4E	105	39	-5	14.7N 126.9E	95	195	-20	15.3N 123.6E	85	604	-5
091800Z	11.7N 129.9E	100	11.9N 129.3E	100	37	0	13.8N 125.3E	110	200	-5	14.8N 121.1E	75	543	-35	17.5N 118.5E	60	875	-20
100000Z	12.4N 129.4E	105	12.1N 129.3E	105	19	0	13.6N 126.1E	115	183	0	14.5N 122.1E	105	555	0	16.8N 117.8E	75	999	5
100600Z	13.1N 129.1E	105	13.0N 128.9E	105	13	0	14.5N 125.8E	115	205	0	16.2N 122.0E	110	581	10	19.2N 117.9E	75	1007	15
101200Z	13.8N 128.8E	110	13.5N 128.9E	110	19	0	15.2N 127.0E	120	171	5	16.9N 125.2E	115	475	25	19.1N 124.0E	110	766	60
101800Z	14.4N 128.7E	115	14.4N 128.9E	115	12	0	16.9N 127.1E	115	176	5	18.9N 125.0E	110	502	30	--.- ---.-	--	--	--
110000Z	15.2N 128.8E	115	15.0N 128.5E	115	21	0	17.1N 127.4E	120	213	15	19.5N 127.2E	115	450	45	--.- ---.-	--	--	--
110600Z	16.0N 129.0E	115	16.1N 128.6E	115	24	0	19.6N 129.4E	105	119	5	22.1N 135.0E	95	115	35	--.- ---.-	--	--	--
111200Z	16.9N 129.4E	115	16.7N 129.4E	115	12	0	18.8N 132.6E	100	132	10	20.5N 138.7E	90	300	40	--.- ---.-	--	--	--
111800Z	17.9N 130.0E	110	17.7N 130.0E	115	12	5	19.9N 133.1E	100	132	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
120000Z	18.8N 130.7E	105	18.7N 130.9E	110	13	5	21.1N 134.8E	85	123	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
120600Z	19.8N 131.5E	100	19.5N 131.2E	100	25	0	22.1N 134.9E	80	116	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
121200Z	21.0N 132.4E	90	21.0N 132.2E	90	11	0	24.2N 136.7E	70	52	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
121800Z	22.1N 133.3E	80	22.0N 133.1E	90	13	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
130000Z	23.1N 134.3E	70	23.2N 133.9E	75	23	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
130600Z	24.0N 135.3E	60	23.0N 134.1E	60	89	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
131200Z	25.0N 136.3E	50	24.4N 136.0E	55	39	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	21NM	112NM	236NM	379NM	21NM	112NM	236NM	379NM
AVERAGE RIGHT ANGLE ERROR	11NM	75NM	157NM	260NM	11NM	75NM	157NM	260NM
AVERAGE MAGNITUDE OF WIND ERROR	2KTS	9KTS	22KTS	27KTS	2KTS	9KTS	22KTS	27KTS
AVERAGE BIAS OF WIND ERROR	0KTS	-0KTS	-8KTS	-22KTS	0KTS	-0KTS	-8KTS	-22KTS
NUMBER OF FORECASTS	41	38	34	30	42	38	34	30

TYPHOON OLGA

0600Z 12 MAY TO 0000Z 27 MAY

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
120600Z	10.5N 136.2E	25	10.8N 136.9E	25	45	0	11.0N 134.4E	35	38	0	11.8N 131.1E	45	58	10	12.9N 128.0E	55	299	20
121200Z	10.7N 135.4E	30	10.8N 136.2E	30	47	0	10.9N 133.3E	40	38	0	11.7N 130.2E	45	85	15	12.6N 127.2E	55	291	15
121800Z	10.9N 134.9E	30	10.6N 135.6E	30	45	0	10.7N 133.1E	40	60	0	11.3N 130.0E	45	246	15	12.3N 126.9E	55	270	10
130000Z	11.2N 134.3E	30	11.3N 133.9E	30	24	0	11.9N 131.6E	35	53	0	12.6N 128.8E	40	289	5	14.3N 126.1E	45	315	-5
130600Z	11.4N 133.9E	35	11.8N 133.6E	35	25	0	12.4N 131.7E	40	21	5	13.4N 129.2E	45	256	10	15.1N 126.5E	50	284	0
131200Z	11.5N 133.5E	40	11.8N 133.4E	35	19	-5	12.3N 132.0E	40	37	10	13.1N 129.7E	45	180	5	14.0N 127.4E	50	168	0
131800Z	11.7N 133.0E	40	11.9N 133.3E	35	21	-5	12.3N 131.5E	40	190	10	13.3N 129.3E	45	171	0	14.2N 126.9E	50	166	0
140000Z	12.0N 132.5E	35	12.0N 132.9E	35	23	0	12.5N 131.0E	40	176	5	13.3N 128.9E	45	146	-5	14.8N 126.0E	50	193	0
140600Z	12.2N 132.0E	35	12.2N 132.5E	35	29	0	12.7N 130.5E	40	171	5	13.6N 128.1E	45	156	-5	15.3N 125.3E	50	189	5
141200Z	12.5N 131.4E	30	12.6N 131.8E	35	24	5	13.5N 130.0E	40	186	0	14.6N 127.8E	45	171	-5	15.9N 125.2E	55	154	10
141800Z	11.4N 134.1E	30	11.6N 134.8E	35	83	5	12.0N 133.8E	45	146	0	12.8N 131.8E	50	131	0	13.8N 130.0E	55	200	10
150000Z	11.6N 133.3E	35	11.2N 133.5E	35	38	0	11.7N 132.0E	45	70	-5	12.6N 130.2E	50	97	0	13.7N 128.5E	55	156	10
150600Z	11.7N 132.6E	35	11.0N 132.8E	35	21	0	11.6N 131.5E	45	76	-5	12.3N 129.7E	50	141	5	13.3N 128.1E	55	177	5
151200Z	11.0N 131.9E	40	11.2N 132.4E	35	32	-5	12.0N 130.5E	45	50	-5	13.5N 128.8E	50	100	5	15.2N 126.1E	55	40	5
151800Z	11.3N 131.4E	45	11.2N 131.5E	35	8	-10	12.2N 129.4E	45	49	-5	14.0N 127.0E	50	51	5	15.9N 124.5E	55	47	5
160000Z	11.7N 130.8E	50	11.4N 130.8E	40	18	-10	12.6N 128.2E	50	97	0	13.9N 125.9E	55	61	10	15.8N 123.2E	60	86	10
160600Z	12.1N 130.3E	50	11.9N 130.3E	45	12	-5	13.1N 128.3E	55	72	10	14.4N 125.8E	60	38	10	15.9N 123.0E	65	84	15
161200Z	12.6N 129.9E	50	12.3N 129.8E	45	19	-5	13.6N 127.7E	55	61	10	15.2N 125.3E	60	6	10	16.7N 122.9E	65	126	10
161800Z	13.3N 129.6E	50	13.0N 129.1E	45	34	-5	14.6N 127.2E	55	31	10	16.3N 125.0E	60	49	10	18.2N 122.6E	65	195	10
170000Z	13.9N 129.2E	50	14.0N 129.3E	55	8	5	16.9N 127.6E	50	147	5	20.6N 126.2E	45	299	-5	24.2N 127.5E	35	512	-25
170600Z	14.3N 128.4E	45	14.5N 128.6E	55	26	10	17.2N 127.0E	45	154	-5	21.0N 125.8E	45	338	-5	24.5N 127.5E	35	530	-30
171200Z	14.6N 127.5E	45	15.0N 127.7E	50	27	5	17.2N 125.4E	45	119	-5	20.1N 124.0E	45	278	-10	22.9N 123.3E	40	382	-30
171800Z	14.8N 126.7E	45	15.1N 126.9E	50	21	5	17.1N 124.4E	45	106	-5	20.0N 122.9E	40	279	-15	22.7N 122.2E	35	371	-50
180000Z	14.9N 126.1E	45	15.1N 125.7E	50	26	5	16.7N 123.3E	50	97	0	18.4N 121.6E	35	215	-25	20.5N 120.5E	35	256	-65
180600Z	15.0N 125.6E	50	14.9N 125.5E	50	8	0	15.5N 122.5E	55	109	5	16.3N 120.2E	35	212	-30	18.0N 118.5E	40	206	-10
181200Z	15.2N 125.4E	50	15.2N 125.1E	55	17	5	15.7N 122.9E	55	104	0	16.3N 120.8E	35	144	-35	17.5N 119.2E	40	145	-5
181800Z	15.5N 125.2E	50	15.1N 125.1E	55	25	5	15.3N 123.0E	55	106	0	16.1N 120.9E	35	106	-50	17.1N 119.5E	40	111	0
190000Z	15.8N 124.7E	50	15.4N 125.0E	55	29	5	15.7N 123.5E	55	62	-5	16.0N 121.3E	50	55	-50	17.1N 119.0E	35	137	0
190600Z	15.5N 124.4E	50	15.5N 124.2E	55	21	5	16.0N 122.6E	55	77	-10	16.8N 119.4E	35	134	-15	18.4N 116.5E	40	297	5
191200Z	15.5N 124.7E	55	15.7N 124.4E	60	21	5	16.2N 123.3E	70	18	0	16.6N 121.0E	55	29	10	17.8N 118.[illegible]	50	201	15
191800Z	15.7N 124.8E	55	15.7N 124.4E	60	23	5	16.2N 123.5E	70	49	-15	16.9N 121.2E	55	42	15	18.2N 118.[illegible]	50	211	15
200000Z	16.1N 124.5E	60	16.0N 124.5E	65	8	5	16.9N 123.5E	70	84	-30	18.6N 121.7E	65	159	30	21.0N 121.1E	65	312	30
200600Z	16.3N 123.9E	65	16.6N 124.2E	65	25	0	19.3N 122.3E	65	177	15	23.2N 122.5E	65	444	30	26.3N 125.1E	65	677	30
201200Z	16.5N 123.3E	70	16.5N 123.5E	65	11	-5	18.3N 122.1E	70	126	25	21.9N 122.2E	70	366	35	25.2N 123.5E	65	588	30
201800Z	16.5N 122.7E	85	16.5N 122.6E	100	6	15	18.2N 120.1E	70	135	30	21.7N 120.2E	85	354	50	24.7N 122.8E	90	544	55
210000Z	16.5N 122.1E	100	16.5N 122.2E	100	6	0	18.1N 120.2E	60	136	25	21.7N 120.2E	70	353	35	24.5N 122.6E	75	519	35
210600Z	16.4N 121.7E	50	16.3N 121.7E	50	6	30	16.5N 119.6E	75	88	40	17.7N 116.5E	85	255	50	20.8N 114.1E	75	421	35
211200Z	16.3N 121.4E	45	16.1N 120.7E	65	42	20	16.8N 118.0E	85	175	50	18.7N 115.1E	85	348	50	21.9N 114.1E	65	443	25
211800Z	16.2N 121.2E	40	16.3N 119.8E	65	61	25	17.0N 117.5E	85	202	50	18.9N 114.8E	85	361	50	22.6N 114.1E	50	446	10
220000Z	16.0N 121.1E	35	16.2N 120.6E	50	31	15	16.0N 119.0E	60	93	25	17.1N 115.9E	65	253	25	20.7N 114.7E	65	327	25
220600Z	15.9N 121.0E	35	16.1N 122.0E	50	59	15	16.8N 121.6E	35	87	0	19.5N 120.7E	45	184	5	21.4N 118.6E	55	212	15
221200Z	15.9N 120.9E	35	15.3N 120.4E	35	40	0	15.2N 119.2E	45	69	10	17.8N 117.1E	50	165	10	21.2N 116.7E	45	218	5
221800Z	15.8N 120.8E	35	15.5N 120.1E	35	44	0	16.2N 118.5E	45	105	10	18.4N 117.2E	50	154	10	21.5N 117.4E	45	241	10
230000Z	15.8N 120.6E	35	15.6N 119.6E	35	59	0	18.0N 116.9E	45	220	5	19.4N 116.0E	50	224	10	21.4N 116.1E	50	290	15
230600Z	15.8N 120.5E	35	16.3N 119.8E	35	50	0	16.8N 118.7E	60	77	20	18.8N 117.3E	60	120	20	22.3N 116.7E	60	338	30
231200Z	15.8N 120.4E	35	16.1N 119.5E	40	55	5	17.3N 118.6E	60	75	20	19.4N 117.6E	60	108	20	--.- ---.-	--	--	--
231800Z	15.9N 120.3E	35	16.0N 119.3E	40	58	5	16.8N 119.0E	55	42	15	17.8N 118.3E	60	143	25	--.- ---.-	--	--	--
240000Z	16.1N 120.2E	40	15.9N 119.9E	35	21	-5	15.9N 119.9E	45	100	5	16.6N 119.6E	45	226	10	--.- ---.-	--	--	--
240600Z	16.5N 120.0E	40	16.1N 119.8E	35	27	-5	17.2N 119.4E	40	43	0	18.6N 119.1E	40	290	10	--.- ---.-	--	--	--
241200Z	16.8N 119.8E	40	16.4N 119.8E	35	24	-5	17.9N 119.8E	40	45	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
241800Z	17.2N 119.6E	40	16.9N 119.8E	35	21	-5	18.2N 119.8E	40	58	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
250000Z	17.5N 119.4E	40	17.4N 119.7E	40	18	0	19.3N 120.3E	45	66	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
250600Z	17.9N 119.2E	40	18.0N 119.9E	35	35	-5	20.2N 120.7E	40	159	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
251200Z	18.4N 119.2E	40	19.0N 121.2E	35	119	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
251800Z	18.8N 120.6E	35	19.8N 121.7E	35	86	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
260000Z	20.1N 121.1E	35	18.9N 120.2E	35	88	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
260600Z	22.0N 122.8E	30	22.7N 123.4E	35	53	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	31NM	95NM	184NM	274NM	33NM	97NM	185NM	275NM
AVERAGE RIGHT ANGLE ERROR	20NM	63NM	106NM	161NM	22NM	60NM	101NM	164NM
AVERAGE MAGNITUDE OF WIND ERROR	6KTS	10KTS	18KTS	16KTS	5KTS	10KTS	18KTS	17KTS
AVERAGE BIAS OF WIND ERROR	2KTS	6KTS	7KTS	6KTS	2KTS	7KTS	7KTS	7KTS
NUMBER OF FORECASTS	50	50	46	44	57	53	49	45

TYPHOON PAMELA

060UZ 14 MAY TO 000UZ 27 MAY

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
140600Z	8.6N 152.8E	30	8.5N 152.1E	25	42	-5	9.3N 150.3E	30	75	-5	10.0N 147.5E	35	354	-25	10.4N 143.8E	45	606	-25
141200Z	8.4N 152.5E	30	8.5N 152.0E	30	30	0	9.5N 150.0E	35	135	-5	10.4N 147.4E	40	405	-25	10.9N 143.5E	45	617	-25
141800Z	8.2N 152.1E	30	8.5N 149.7E	30	143	0	8.7N 147.8E	35	220	-10	9.0N 145.4E	40	496	-30	9.5N 142.7E	45	619	-30
150000Z	8.3N 151.6E	30	8.5N 149.5E	30	125	0	8.9N 147.4E	35	295	-15	9.5N 145.0E	40	533	-30	10.0N 142.7E	50	583	-30
150600Z	8.2N 150.9E	35	8.4N 151.1E	35	17	0	8.6N 149.2E	40	224	-20	9.0N 147.0E	45	401	-25	9.6N 144.6E	50	429	-35
151200Z	7.3N 150.5E	40	8.1N 150.8E	35	51	-5	8.5N 148.8E	45	276	-20	9.2N 146.8E	50	401	-20	9.9N 144.7E	60	368	-35
151800Z	6.4N 150.7E	45	7.5N 150.5E	35	67	-10	7.9N 149.0E	45	274	-25	8.6N 147.1E	50	354	-25	9.4N 144.8E	60	301	-45
160000Z	6.1N 151.5E	50	6.8N 151.7E	40	43	-10	8.0N 151.3E	50	154	-20	8.3N 149.4E	60	178	-20	8.8N 147.1E	70	116	-45
160600Z	6.6N 152.4E	60	7.0N 153.0E	70	43	10	8.5N 151.4E	90	150	20	9.5N 149.3E	100	157	15	10.5N 146.6E	110	106	-15
161200Z	6.5N 153.0E	65	6.9N 153.4E	70	34	5	8.8N 152.2E	90	111	20	9.9N 150.1E	100	67	5	10.9N 147.1E	110	55	-20
161800Z	6.5N 153.4E	70	6.2N 153.6E	70	21	0	8.1N 153.8E	90	56	15	9.2N 151.8E	100	113	-5	10.5N 148.6E	110	82	-20
170000Z	6.8N 153.6E	70	6.9N 153.6E	75	6	5	8.6N 152.1E	90	35	10	9.8N 149.6E	100	43	-15	11.0N 146.6E	110	0	-20
170600Z	7.1N 153.5E	70	7.2N 153.6E	75	8	5	8.7N 152.1E	90	19	5	10.1N 149.7E	100	83	-25	11.4N 146.7E	110	30	-15
171200Z	7.3N 153.3E	70	7.7N 153.1E	75	27	5	9.0N 151.4E	90	30	-5	10.5N 148.9E	100	73	-30	11.6N 145.9E	110	0	-15
171800Z	7.6N 153.0E	75	7.7N 153.2E	80	13	5	8.9N 151.6E	95	106	-10	10.3N 149.2E	105	119	-25	11.5N 146.3E	115	50	-5
180000Z	8.1N 152.4E	80	7.9N 152.9E	80	32	0	9.2N 151.3E	95	143	-20	10.5N 148.5E	105	115	-25	11.5N 144.7E	115	93	-5
180600Z	8.6N 151.8E	85	8.6N 151.8E	90	0	5	10.2N 148.8E	120	34	-5	11.5N 145.1E	130	66	5	12.6N 141.2E	130	219	10
181200Z	9.1N 150.9E	95	9.1N 151.2E	95	18	0	11.0N 147.9E	120	49	-10	12.4N 144.2E	130	110	5	13.5N 140.2E	130	245	10
181800Z	9.5N 149.9E	105	9.8N 150.2E	100	25	-5	11.6N 146.5E	120	72	-10	12.9N 142.7E	130	181	10	13.8N 138.8E	130	305	10
190000Z	9.6N 148.9E	115	9.8N 149.3E	105	26	-10	11.3N 145.4E	120	73	-10	12.5N 141.5E	130	228	10	13.4N 137.6E	130	358	10
190600Z	9.9N 148.3E	125	9.9N 148.1E	115	12	-10	11.3N 144.2E	130	117	5	13.0N 140.6E	130	251	10	15.0N 138.1E	130	277	10
191200Z	10.2N 147.7E	130	10.1N 147.4E	120	8	-10	11.1N 144.5E	130	87	5	12.3N 142.0E	130	169	10	13.5N 139.9E	130	268	10
191800Z	10.6N 147.2E	130	10.3N 147.2E	120	18	-10	11.5N 144.6E	130	74	10	13.2N 142.4E	130	125	10	14.7N 140.6E	130	230	10
200000Z	11.0N 146.6E	130	11.1N 146.4E	130	6	0	13.2N 144.2E	135	72	15	14.3N 141.6E	130	126	10	16.0N 139.3E	120	213	5
200600Z	11.3N 146.2E	125	11.3N 146.1E	130	6	5	12.9N 144.4E	135	38	15	15.4N 142.3E	130	64	10	17.1N 139.5E	120	178	5
201200Z	11.6N 145.9E	125	11.4N 146.0E	130	13	5	12.8N 144.4E	135	66	15	15.3N 142.4E	130	133	10	17.1N 139.7E	120	215	5
201800Z	12.1N 145.7E	120	12.0N 145.7E	125	6	5	13.7N 144.2E	120	55	0	16.1N 142.2E	130	152	-10	18.8N 140.8E	100	165	-10
210000Z	12.9N 145.4E	120	12.7N 145.4E	120	12	0	14.4N 144.4E	115	87	-5	16.5N 143.2E	110	219	-5	18.7N 142.2E	100	237	-10
210600Z	13.3N 144.9E	120	13.7N 144.8E	140	25	20	16.5N 143.3E	120	35	0	20.3N 142.5E	100	130	-15	24.7N 144.7E	85	249	-15
211200Z	13.9N 144.4E	120	14.0N 144.4E	130	6	10	16.0N 143.2E	110	113	-10	18.3N 142.1E	110	189	-5	21.6N 141.7E	105	131	15
211800Z	14.6N 144.0E	120	14.5N 144.1E	130	8	10	16.6N 142.7E	110	139	-10	19.8N 141.5E	110	135	0	23.2N 141.3E	105	66	25
220000Z	15.5N 143.4E	120	15.5N 143.6E	135	12	15	17.5N 141.7E	125	122	10	21.5N 139.8E	125	47	15	27.1N 143.6E	115	162	40
220600Z	16.4N 142.7E	120	16.5N 142.9E	130	8	10	19.7N 141.2E	120	59	5	23.8N 141.1E	120	60	20	28.3N 143.0E	100	161	30
221200Z	17.5N 142.0E	120	17.4N 142.4E	120	24	0	20.8N 141.0E	115	62	0	25.1N 141.6E	105	90	15	29.8N 144.8E	95	234	30
221800Z	18.5N 141.3E	120	18.0N 141.7E	120	38	0	21.3N 140.6E	110	45	0	25.8N 141.6E	105	90	25	30.2N 147.2E	95	272	35
230000Z	19.3N 140.7E	115	19.5N 141.3E	120	36	5	22.7N 139.7E	120	41	10	25.8N 139.8E	110	113	35	29.6N 143.4E	95	125	40
230600Z	20.0N 140.2E	115	20.1N 140.2E	130	6	15	23.8N 137.8E	120	163	20	26.7N 137.0E	110	285	40	29.3N 138.3E	95	417	45
231200Z	20.7N 139.9E	115	20.9N 139.7E	130	16	15	24.2N 137.6E	115	188	25	28.6N 138.6E	105	262	40	--.- ---.-	--	--	--
231800Z	21.4N 139.8E	110	21.7N 139.8E	115	18	5	25.3N 139.7E	105	110	25	30.0N 144.3E	95	184	35	--.- ---.-	--	--	--
240000Z	22.2N 140.2E	110	22.0N 140.0E	110	16	0	25.0N 140.7E	100	54	25	30.4N 147.0E	65	200	10	--.- ---.-	--	--	--
240600Z	22.9N 140.6E	100	22.7N 140.7E	90	13	-10	28.4N 145.9E	60	254	-10	37.0N 158.7E	40	810	-10	--.- ---.-	--	--	--
241200Z	23.7N 141.0E	90	24.2N 141.9E	75	57	-15	30.4N 148.8E	50	399	-15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
241800Z	24.3N 141.4E	80	25.5N 143.0E	70	112	-10	31.4N 150.2E	50	437	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
250000Z	25.0N 141.7E	75	24.6N 141.7E	80	24	5	27.1N 143.1E	65	90	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
250600Z	25.7N 142.2E	70	25.6N 141.5E	80	38	10	29.0N 144.6E	60	91	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
251200Z	26.3N 142.8E	65	26.2N 142.2E	75	33	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
251800Z	27.0N 143.5E	60	27.3N 143.2E	65	24	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
260000Z	27.8N 144.6E	55	28.1N 144.4E	60	21	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
260600Z	28.4N 146.2E	50	28.9N 145.7E	60	40	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	24NM	123NM	203NM	237NM	29NM	123NM	203NM	237NM
AVERAGE RIGHT ANGLE ERROR	13NM	66NM	119NM	126NM	15NM	66NM	119NM	126NM
AVERAGE MAGNITUDE OF WIND ERROR	7KTS	12KTS	17KTS	21KTS	6KTS	12KTS	17KTS	21KTS
AVERAGE BIAS OF WIND ERROR	2KTS	1KTS	-1KTS	-2KTS	2KTS	1KTS	-1KTS	-2KTS
NUMBER OF FORECASTS	45	45	41	37	49	45	41	37

TYPHOON RUBY

0000Z 23 JUN TO 0000Z 04 JUL

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
230000Z	11.6N 127.6E	30	12.2N 128.0E	30	43	0	12.9N 123.8E	40	82	-5	13.5N 120.1E	30	166	-50	14.4N 116.1E	35	260	-20
230600Z	11.7N 127.1E	35	12.3N 127.0E	30	36	-5	13.1N 123.2E	35	87	-15	13.7N 119.6E	30	176	-35	14.5N 115.7E	35	273	-20
231200Z	11.9N 126.6E	40	12.0N 126.5E	40	3	0	12.3N 122.5E	35	136	-25	13.5N 119.0E	35	222	-25	15.0N 115.1E	35	276	-20
231800Z	12.3N 125.9E	40	12.0N 125.6E	40	25	0	12.2N 122.3E	35	161	-35	13.5N 118.8E	35	269	-25	15.0N 115.0E	35	300	-20
240000Z	12.9N 125.2E	45	12.5N 125.0E	45	27	0	13.2N 121.8E	30	133	-50	14.6N 118.4E	35	229	-20	16.2N 114.8E	40	268	-15
240600Z	13.6N 124.6E	50	13.5N 124.5E	50	8	0	15.7N 121.4E	65	32	0	17.5N 116.2E	40	93	-15	20.1N 114.4E	45	180	-15
241200Z	14.2N 123.8E	60	14.3N 123.9E	50	8	-10	16.1N 120.2E	40	54	-20	18.0N 116.7E	45	75	-10	20.1N 113.2E	45	270	-15
241800Z	14.8N 123.0E	70	14.8N 123.1E	65	6	-5	16.6N 119.4E	70	85	10	18.5N 116.8E	75	68	20	20.5N 114.9E	70	169	10
250000Z	15.4N 122.2E	80	15.4N 122.2E	80	0	0	17.1N 118.7E	75	90	20	19.2N 116.2E	70	78	15	21.3N 114.3E	65	200	0
250600Z	16.2N 121.2E	65	15.9N 121.3E	70	19	5	18.0N 118.4E	75	79	20	20.0N 116.0E	70	91	10	21.9N 114.0E	65	243	0
251200Z	17.0N 120.3E	60	16.6N 120.8E	65	31	5	19.1N 117.9E	75	46	20	21.2N 115.5E	70	144	10	22.9N 113.2E	65	323	0
251800Z	18.0N 119.1E	60	17.4N 120.2E	65	72	5	19.9N 117.2E	70	19	15	22.4N 114.6E	65	204	5	23.6N 113.0E	40	384	-25
260000Z	18.4N 117.9E	55	18.5N 118.5E	60	35	5	21.6N 115.1E	45	156	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
260600Z	18.8N 117.3E	55	18.8N 117.4E	55	6	0	21.4N 113.7E	40	227	-20	23.6N 111.9E	20	381	-45	--.- ---.-	--	--	--
261200Z	19.2N 117.1E	55	19.3N 116.8E	60	18	5	21.7N 113.9E	50	238	-10	24.1N 112.2E	25	401	-40	--.- ---.-	--	--	--
261800Z	19.6N 117.1E	55	19.7N 116.2E	60	51	5	21.9N 113.8E	50	236	-10	24.3N 112.1E	20	446	-45	--.- ---.-	--	--	--
270000Z	20.0N 117.3E	55	20.0N 116.1E	55	67	0	22.3N 113.9E	50	231	-15	25.0N 113.5E	20	432	-50	--.- ---.-	--	--	--
270600Z	20.3N 117.6E	60	20.5N 115.9E	55	96	-5	23.2N 114.3E	40	251	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
271200Z	20.6N 118.0E	60	20.4N 117.1E	55	52	-5	22.6N 117.3E	55	119	-10	25.0N 117.8E	35	318	-35	--.- ---.-	--	--	--
271800Z	20.9N 117.9E	60	20.3N 117.1E	55	45	-5	22.7N 117.3E	50	154	-15	25.1N 117.8E	35	340	-35	--.- ---.-	--	--	--
280000Z	21.2N 117.9E	65	21.2N 117.8E	65	6	0	22.5N 119.0E	55	113	-15	24.5N 120.5E	50	224	-20	27.0N 122.5E	50	310	-40
280600Z	21.2N 118.3E	65	21.7N 117.9E	65	23	0	22.1N 118.6E	60	135	-10	22.8N 120.1E	60	203	-15	23.2N 121.5E	45	302	-50
281200Z	21.1N 118.7E	65	21.0N 118.7E	70	6	5	21.4N 120.3E	70	73	0	22.7N 122.3E	65	129	-15	24.7N 124.4E	55	204	-45
281800Z	20.9N 119.3E	65	21.0N 119.1E	75	13	10	21.4N 120.8E	70	87	0	23.1N 122.9E	65	130	-20	24.8N 125.6E	55	211	-55
290000Z	20.3N 119.9E	70	20.8N 120.4E	75	28	5	21.6N 122.8E	70	12	0	23.4N 125.6E	65	37	-25	25.4N 128.0E	55	157	-65
290600Z	20.7N 120.7E	70	20.8N 120.7E	75	6	5	21.8N 123.4E	70	30	-5	23.2N 126.3E	65	42	-30	25.1N 128.9E	55	197	-65
291200Z	20.9N 121.5E	70	20.9N 121.6E	75	6	5	21.8N 124.2E	70	13	-10	23.4N 126.7E	65	87	-35	25.4N 129.3E	55	266	-55
291800Z	21.2N 122.3E	70	21.2N 122.2E	75	6	5	21.8N 124.6E	70	41	-15	23.6N 127.0E	65	157	-45	26.3N 1[illegible].0E	55	378	-45
300000Z	21.4N 122.8E	70	21.4N 123.0E	75	11	5	22.5N 125.9E	70	25	-20	24.4N 128.1E	65	168	-55	26.5N 129.9E	65	453	-25
300600Z	21.3N 123.4E	75	21.6N 123.7E	75	21	0	23.3N 125.1E	80	105	-15	25.2N 127.2E	85	282	-35	27.4N 129.3E	85	604	5
301200Z	21.6N 124.3E	80	22.0N 123.9E	80	37	0	24.2N 126.2E	90	104	-10	26.5N 128.5E	90	290	-20	28.7N 130.6E	85	650	15
301800Z	22.3N 125.1E	85	22.3N 125.1E	80	0	-5	24.7N 127.3E	90	120	-20	27.3N 129.3E	90	348	-10	--.- ---.-	--	--	--
010000Z	22.9N 126.0E	90	22.9N 125.9E	85	6	-5	25.9N 128.7E	100	120	-20	28.9N 130.9E	95	361	5	--.- ---.-	--	--	--
010600Z	23.5N 127.0E	95	23.6N 126.8E	90	12	-5	26.8N 129.4E	100	158	-20	29.9N 132.0E	90	426	10	--.- ---.-	--	--	--
011200Z	24.1N 128.1E	100	24.2N 127.8E	95	17	-5	27.7N 130.0E	105	210	-5	30.5N 132.8E	95	509	25	--.- ---.-	--	--	--
011800Z	24.9N 129.5E	110	25.0N 129.7E	100	12	-10	29.0N 132.6E	110	174	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
020000Z	25.6N 130.9E	120	25.6N 130.4E	110	27	-10	28.0N 135.0E	100	172	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
020600Z	26.3N 132.3E	120	26.3N 132.3E	105	0	-15	29.2N 138.7E	90	123	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
021200Z	27.1N 133.9E	110	27.1N 134.9E	105	53	-5	30.1N 142.8E	85	120	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
021800Z	28.2N 135.8E	100	28.2N 135.4E	95	21	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
030000Z	29.5N 137.8E	90	29.4N 137.7E	85	8	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
030600Z	30.8N 140.2E	80	30.6N 139.5E	80	38	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
031200Z	32.1N 142.6E	70	32.6N 142.8E	75	32	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	24NM	117NM	228NM	299NM	24NM	117NM	228NM	299NM
AVERAGE RIGHT ANGLE ERROR	16NM	84NM	147NM	175NM	17NM	84NM	147NM	175NM
AVERAGE MAGNITUDE OF WIND ERROR	4KTS	14KTS	26KTS	27KTS	4KTS	14KTS	26KTS	27KTS
AVERAGE BIAS OF WIND ERROR	-1KTS	-5KTS	-20KTS	-27KTS	-1KTS	-8KTS	-20KTS	-25KTS
NUMBER OF FORECASTS	42	39	33	23	43	39	33	23

TYPHOON SALLY

0000Z 24 JUN TO 0000Z 03 JUL

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
240000Z	9.5N 145.1E	25	9.?N 145.?E	30	6	5	9.6N 143.0E	35	142	0	10.6N 139.9E	45	306	-5	11.9N 136.1E	55	350	-15
240600Z	9.7N 144.4E	30	9.5N 144.?E	30	26	0	9.7N 142.9E	35	213	-5	10.6N 139.8E	45	368	-10	11.9N 135.9E	55	390	-2?
241200Z	10.1N 143.9E	30	10.1N 143.7E	30	0	0	11.4N 140.5E	45	136	5	12.5N 136.6E	55	253	-5	13.3N 132.8E	60	311	-25
241800Z	10.8N 143.1E	35	10.5N 143.2E	35	19	0	12.1N 139.8E	45	153	0	13.4N 135.8E	55	224	-10	14.5N 131.9E	65	264	-30
250000Z	11.0N 142.1E	35	11.3N 142.5E	35	38	0	13.9N 138.9E	55	118	5	16.0N 135.1E	70	98	0	17.6N 130.5E	85	144	-20
250600Z	12.0N 141.1E	40	12.7N 140.9E	35	13	-5	15.6N 136.6E	50	17	-5	17.6N 132.3E	65	90	-10	18.9N 127.7E	85	279	-30
251200Z	13.4N 139.4E	40	13.6N 140.3E	35	54	-5	16.9N 136.5E	50	58	-10	19.0N 132.1E	65	54	-20	20.1N 127.3E	75	308	-35
251800Z	14.2N 138.3E	45	14.1N 139.1E	35	47	-10	16.7N 134.8E	50	33	-15	18.6N 130.1E	65	131	-30	19.9N 125.2E	75	451	-3?
260000Z	15.0N 137.2E	50	14.7N 137.3E	45	19	-5	17.2N 132.8E	65	111	-5	19.7N 129.1E	80	188	-25	22.4N 126.7E	90	397	-15
260600Z	15.8N 136.4E	55	15.7N 136.3E	50	8	-5	18.7N 132.3E	65	92	-10	21.5N 128.9E	75	236	-40	24.1N 126.4E	85	457	-15
261200Z	16.6N 135.5E	60	16.5N 135.1E	55	24	-5	19.7N 131.2E	70	120	-15	22.2N 128.5E	80	280	-30	25.1N 126.2E	90	510	-10
261800Z	17.1N 135.2E	65	17.0N 134.7E	60	29	-5	19.7N 131.1E	70	87	-25	22.5N 128.0E	80	306	-25	25.6N 126.1E	90	573	-5
270000Z	17.6N 134.7E	70	17.5N 134.3E	65	24	-5	19.9N 132.1E	75	40	-30	22.1N 130.0E	80	214	-25	25.0N 128.8E	90	474	-5
270600Z	18.1N 133.8E	75	18.0N 133.9E	70	8	-5	20.7N 131.9E	80	77	-35	23.4N 130.0E	90	256	-10	26.4N 129.4E	85	503	-5
271200Z	18.5N 132.9E	85	18.7N 133.3E	75	26	-10	21.4N 131.1E	85	123	-25	24.2N 129.6E	90	318	-10	26.7N 129.3E	90	583	0
271800Z	18.9N 132.4E	95	19.1N 132.3E	90	13	-5	21.7N 130.1E	130	181	25	24.3N 128.9E	120	410	25	26.7N 129.1E	110	666	25
280000Z	19.2N 132.4E	105	19.4N 132.?E	100	26	-5	21.5N 130.0E	115	211	10	24.?N 129.0E	110	464	15	26.5N 129.1E	105	768	25
280600Z	19.6N 132.6E	115	19.5N 131.9E	110	40	-5	21.0N 130.6E	125	219	25	22.?N 129.9E	120	522	30	24.2N 129.1E	110	915	30
281200Z	21.1N 132.6E	110	19.9N 132.?E	105	18	-5	20.9N 133.1E	85	146	-15	22.4N 132.7E	65	467	-25	24.2N 131.6E	50	897	-30
281800Z	20.8N 133.2E	105	20.5N 132.9E	105	25	0	22.6N 132.1E	85	234	-10	25.2N 130.9E	65	583	-20	27.8N 131.4E	50	984	-25
290000Z	21.5N 133.8E	105	21.5N 133.2E	105	35	0	24.2N 132.9E	85	251	-10	26.9N 131.8E	75	622	-5	29.3N 130.2E	65	1147	-5
290600Z	22.0N 134.4E	100	21.9N 134.1E	105	18	5	24.9N 135.1E	85	197	-5	28.0N 135.3E	75	549	-5	30.9N 135.5E	65	962	5
291200Z	22.5N 135.1E	100	22.5N 135.1E	105	0	5	25.6N 137.2E	90	165	0	29.2N 138.8E	80	477	0	32.6N 140.8E	70	817	20
291800Z	23.2N 136.3E	95	23.0N 135.9E	105	30	10	26.3N 138.2E	90	185	5	30.2N 140.0E	80	531	5	--.- ---.-	--	--	--
300000Z	24.3N 137.5E	95	24.2N 137.4E	100	8	5	27.4N 141.3E	85	117	5	30.8N 146.5E	75	305	5	--.- ---.-	--	--	--
300600Z	25.4N 138.7E	90	25.1N 138.?E	95	23	5	27.8N 142.2E	80	185	0	31.4N 147.5E	70	348	10	--.- ---.-	--	--	--
301200Z	26.2N 140.2E	90	25.9N 139.7E	90	52	0	29.0N 144.0E	80	208	0	32.3N 150.5E	70	328	20	--.- ---.-	--	--	--
301800Z	26.9N 141.6E	85	27.2N 141.7E	90	28	5	30.7N 147.0E	80	197	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010000Z	27.3N 143.5E	80	27.5N 143.4E	85	13	5	31.0N 150.9E	70	102	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010600Z	27.7N 145.7E	80	28.4N 145.7E	80	49	0	32.2N 154.5E	65	72	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
011200Z	28.0N 147.8E	80	28.2N 147.2E	80	34	0	30.1N 157.1E	65	126	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
011800Z	28.8N 150.1E	75	28.7N 149.4E	80	37	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
020000Z	29.8N 152.3E	70	29.5N 151.7E	70	36	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
020600Z	31.0N 154.3E	60	30.0N 154.2E	65	60	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
021200Z	32.2N 157.0E	50	32.4N 158.1E	55	57	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	28NM	139NM	331NM	572NM	27NM	139NM	331NM	572NM
AVERAGE RIGHT ANGLE ERROR	17NM	78NM	192NM	334NM	16NM	78NM	192NM	334NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	10KTS	16KTS	18KTS	4KTS	10KTS	16KTS	18KTS
AVERAGE BIAS OF WIND ERROR	-0KTS	-4KTS	-7KTS	-9KTS	-0KTS	-4KTS	-7KTS	-9KTS
NUMBER OF FORECASTS	32	31	27	23	35	31	27	23

TYPHOON THERESE

0000Z 11 JUL TO 0000Z 20 JUL

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
110000Z	9.3N 155.6E	40	9.5N 155.7E	35	13	-5	10.2N 152.4E	55	59	-10	11.2N 148.4E	70	40	-50	12.5N 144.2E	85	243	-45
110600Z	9.4N 154.7E	50	9.5N 154.9E	40	3	-10	10.2N 151.1E	60	30	-15	11.8N 147.0E	75	84	-60	13.4N 142.4E	90	269	-35
111200Z	9.6N 153.7E	55	9.5N 153.7E	40	6	-15	10.1N 149.9E	60	36	-30	12.1N 145.9E	75	138	-60	13.6N 141.2E	90	337	-35
111800Z	9.9N 152.6E	60	9.9N 152.9E	45	18	-15	10.8N 149.2E	65	25	-40	12.2N 145.1E	80	194	-50	14.2N 140.5E	100	354	-20
120000Z	10.1N 151.4E	65	10.0N 152.4E	55	59	-10	10.8N 148.8E	75	60	-45	12.5N 144.7E	90	236	-40	13.9N 140.0E	105	418	-15
120600Z	10.3N 150.6E	75	10.3N 150.6E	65	0	-10	11.6N 146.7E	85	105	-50	13.3N 142.6E	100	271	-25	14.3N 137.8E	115	432	0
121200Z	10.7N 149.9E	90	10.8N 149.4E	70	30	-20	12.6N 144.9E	95	167	-40	13.9N 140.1E	115	340	-10	14.7N 135.3E	125	462	10
121800Z	11.2N 149.3E	105	11.3N 148.6E	80	41	-25	12.8N 144.3E	100	191	-30	14.3N 139.8E	120	354	0	15.3N 134.9E	130	452	20
130000Z	11.8N 148.7E	120	11.7N 148.6E	100	8	-20	13.4N 145.8E	130	181	0	15.3N 142.2E	140	363	20	17.2N 138.7E	145	432	40
130600Z	12.7N 148.1E	135	12.1N 148.0E	120	36	-15	13.8N 145.2E	140	236	15	15.6N 141.6E	145	394	30	17.7N 138.1E	145	454	45
131200Z	13.8N 147.5E	135	13.3N 147.4E	135	30	0	16.7N 145.1E	145	206	20	19.0N 142.0E	140	325	25	20.8N 138.3E	130	403	30
131800Z	15.1N 146.6E	130	14.7N 146.8E	130	27	0	18.5N 144.0E	125	189	5	21.1N 140.2E	110	254	0	22.8N 136.3E	100	323	5
140000Z	16.4N 145.4E	130	15.9N 145.8E	130	38	0	19.1N 142.0E	120	168	0	21.1N 138.3E	110	236	5	22.8N 134.5E	100	318	5
140600Z	17.6N 144.1E	125	17.2N 144.6E	125	37	0	20.2N 139.8E	120	106	5	22.3N 135.2E	110	135	10	24.0N 131.4E	100	204	10
141200Z	19.1N 142.5E	125	19.0N 142.4E	125	8	0	22.5N 136.0E	115	74	0	25.2N 131.2E	105	69	5	28.7N 129.3E	90	63	0
141800Z	20.1N 141.1E	120	19.8N 141.1E	120	18	0	22.9N 135.2E	110	44	0	25.8N 131.0E	100	24	5	29.0N 129.3E	85	50	0
150000Z	20.9N 139.7E	120	20.9N 139.8E	120	6	0	25.3N 133.9E	110	120	5	29.6N 131.5E	100	210	5	33.1N 133.8E	85	347	0
150600Z	21.5N 138.5E	115	21.6N 138.2E	120	18	5	25.6N 132.3E	110	117	10	29.5N 131.0E	105	177	15	32.9N 132.2E	100	243	20
151200Z	22.2N 137.3E	115	22.4N 136.9E	120	25	5	25.8N 132.2E	110	61	10	29.6N 131.0E	105	158	15	33.1N 132.1E	90	209	15
151800Z	22.8N 136.0E	110	22.9N 136.0E	130	6	20	25.9N 131.6E	115	40	20	29.3N 129.5E	100	68	15	32.9N 130.9E	75	112	5
160000Z	23.5N 134.9E	105	23.7N 134.6E	110	20	5	26.4N 130.4E	100	17	5	29.6N 129.7E	95	79	10	32.1N 131.7E	85	130	25
160600Z	24.1N 133.7E	100	24.3N 133.8E	105	13	5	26.6N 130.1E	95	41	5	28.4N 126.9E	85	156	5	29.9N 123.9E	75	352	35
161200Z	24.8N 132.4E	100	24.9N 132.4E	100	6	0	27.5N 128.0E	95	49	5	29.7N 124.3E	85	238	10	31.6N 121.3E	75	454	45
161800Z	25.4N 131.1E	95	25.6N 131.3E	95	16	0	28.0N 127.2E	90	76	5	30.2N 123.4E	85	303	15	32.3N 120.6E	75	489	50
170000Z	26.3N 130.1E	95	26.1N 130.0E	90	13	-5	28.5N 125.3E	75	170	-10	30.6N 122.5E	65	361	5	32.5N 121.7E	60	434	40
170600Z	26.9N 129.4E	90	26.8N 129.1E	90	17	0	29.3N 125.0E	70	184	-10	31.3N 123.6E	60	331	20	--.- ---.-	--	--	--
171200Z	27.7N 128.9E	90	27.4N 128.8E	85	19	-5	29.3N 126.4E	70	174	-5	31.5N 125.5E	60	247	30	--.- ---.-	--	--	--
171800Z	28.7N 128.4E	85	28.8N 128.3E	85	8	0	32.7N 128.3E	70	35	0	36.0N 130.7E	60	216	35	--.- ---.-	--	--	--
180000Z	29.8N 128.2E	85	29.7N 128.2E	85	6	0	33.8N 128.8E	75	74	15	37.0N 132.7E	50	310	30	--.- ---.-	--	--	--
180600Z	30.8N 128.1E	80	30.7N 128.0E	80	8	0	34.6N 129.5E	65	109	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
181200Z	31.7N 128.3E	75	31.5N 128.2E	80	13	5	35.6N 130.4E	65	179	35	--.- ---.-	--	--	--	--.- ---.-	--	--	--
181800Z	32.3N 128.8E	70	32.2N 128.8E	80	6	10	35.9N 131.6E	65	219	40	--.- ---.-	--	--	--	--.- ---.-	--	--	--
190000Z	32.6N 129.2E	60	32.8N 129.3E	70	13	10	35.7N 132.6E	55	238	35	--.- ---.-	--	--	--	--.- ---.-	--	--	--
190600Z	32.3N 129.9E	40	33.0N 129.8E	65	13	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
191200Z	32.6N 130.2E	30	33.1N 129.9E	45	33	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
191800Z	32.4N 130.3E	25	33.1N 130.0E	40	44	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
200000Z	32.2N 130.3E	20	32.8N 130.1E	30	37	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	18NM	105NM	213NM	300NM	19NM	115NM	218NM	319NM
AVERAGE RIGHT ANGLE ERROR	9NM	63NM	139NM	182NM	10NM	75NM	146NM	203NM
AVERAGE MAGNITUDE OF WIND ERROR	7KTS	15KTS	20KTS	19KTS	8KTS	17KTS	21KTS	22KTS
AVERAGE BIAS OF WIND ERROR	-2KTS	-5KTS	-3KTS	5KTS	-1KTS	-1KTS	1KTS	10KTS
NUMBER OF FORECASTS	34	30	26	22	37	33	29	25

TYPHOON ANITA

0000Z 23 JUL TO 0000Z 25 JUL

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
230000Z	19.5N 133.2E	45	18.9N 132.9E	50	40	5	22.7N 134.8E	75	275	20	25.8N 135.9E	65	560	60	--.- ---.-	--	--	--
230600Z	21.1N 133.4E	55	19.8N 133.5E	50	78	-5	25.3N 136.4E	75	310	30	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231200Z	22.9N 133.3E	65	22.4N 133.0E	65	34	0	27.8N 132.6E	75	182	40	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231800Z	24.3N 133.0E	65	24.9N 132.9E	65	8	0	31.7N 131.1E	50	31	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240000Z	26.9N 132.7E	55	26.7N 133.0E	50	20	-5	33.6N 132.1E	40	109	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240600Z	28.9N 132.2E	45	29.1N 131.8E	50	24	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
241200Z	30.7N 131.5E	35	30.9N 131.9E	45	24	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
241800Z	31.1N 130.7E	30	31.9N 130.8E	35	13	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
250000Z	33.6N 129.9E	25	33.4N 130.1E	35	16	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	32NM	256NM	0NM	0NM	28NM	182NM	560NM	0NM
AVERAGE RIGHT ANGLE ERROR	20NM	92NM	0NM	0NM	18NM	77NM	163NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	4KTS	30KTS	0KTS	0KTS	5KTS	25KTS	60KTS	0KTS
AVERAGE BIAS OF WIND ERROR	1KTS	30KTS	0KTS	0KTS	3KTS	25KTS	60KTS	0KTS
NUMBER OF FORECASTS	7	3	0	0	9	5	1	0

TYPHOON BILLIE

0000Z 03 AUG TO 1200Z 10 AUG

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
030000Z	13.7N 146.6E	30	13.8N 146.5E	30	8	0	16.7N 145.0E	45	60	5	19.2N 143.1E	60	246	0	21.8N 141.7E	70	305	0
030600Z	14.2N 146.2E	30	14.7N 146.2E	30	30	0	17.3N 144.6E	45	102	0	19.9N 142.7E	60	288	0	22.5N 140.5E	70	303	-5
031200Z	14.7N 145.9E	30	14.9N 145.8E	30	13	0	16.9N 144.2E	45	102	-5	19.5N 142.3E	60	245	0	21.9N 140.2E	70	240	-10
031800Z	15.3N 145.6E	35	15.5N 145.4E	40	18	5	17.7N 144.3E	60	157	5	19.7N 142.4E	75	220	10	21.8N 139.7E	85	217	-5
040000Z	15.7N 145.1E	40	16.1N 145.2E	50	25	10	18.1N 143.7E	70	160	10	19.8N 141.4E	85	185	15	21.8N 138.3E	95	176	-10
040600Z	15.6N 144.6E	45	16.2N 144.8E	55	38	10	17.8N 142.7E	75	163	15	19.8N 140.1E	90	140	15	21.4N 137.3E	100	155	-20
041200Z	15.2N 144.3E	50	15.2N 144.2E	55	6	5	14.4N 145.1E	60	167	0	16.0N 145.0E	65	406	-15	18.4N 142.9E	70	566	-55
041800Z	15.1N 143.9E	55	15.0N 144.3E	55	24	0	14.8N 145.7E	60	248	-5	16.5N 144.2E	65	440	-25	17.4N 140.9E	70	572	-50
050000Z	15.1N 143.5E	60	15.1N 143.5E	60	0	0	15.3N 141.1E	75	94	5	17.5N 138.2E	90	202	-15	19.9N 135.0E	100	289	-15
050600Z	15.1N 143.1E	60	15.2N 143.1E	60	6	0	16.1N 140.9E	65	112	-10	18.4N 138.1E	80	244	-40	20.7N 134.7E	95	322	-15
051200Z	15.4N 142.4E	60	15.3N 142.7E	60	18	0	15.8N 140.4E	70	192	-10	18.0N 137.4E	85	311	-40	20.3N 134.0E	100	380	-5
051800Z	16.1N 141.6E	65	15.6N 142.0E	60	38	-5	16.8N 139.1E	75	186	-15	19.1N 136.1E	90	294	-30	21.0N 132.3E	105	345	5
060000Z	16.8N 140.6E	70	16.6N 140.6E	65	12	-5	18.8N 137.0E	80	99	-25	20.8N 133.1E	90	176	-25	22.7N 129.3E	105	222	10
060600Z	17.5N 139.6E	75	17.5N 139.5E	70	6	-5	20.0N 135.7E	90	78	-30	22.2N 131.9E	100	143	-10	24.3N 127.8E	105	185	15
061200Z	18.3N 138.3E	80	18.3N 138.5E	75	11	-5	20.7N 134.4E	95	77	-30	23.0N 130.3E	105	123	0	25.0N 126.2E	105	179	15
061800Z	19.2N 137.0E	90	18.9N 137.3E	80	25	-10	21.7N 132.9E	100	57	-20	23.9N 128.8E	105	104	5	25.7N 124.3E	100	166	25
070000Z	20.9N 135.8E	105	20.0N 135.6E	95	11	-10	23.2N 130.2E	110	50	-5	25.3N 125.7E	110	66	15	27.0N 121.9E	100	160	40
070600Z	21.8N 134.6E	120	20.7N 134.5E	120	8	0	23.7N 129.7E	130	8	20	25.9N 125.3E	120	97	30	27.7N 121.3E	105	195	60
071200Z	21.6N 133.4E	125	21.5N 133.2E	130	13	5	24.3N 128.5E	125	39	20	26.6N 124.9E	115	152	25	28.6N 122.1E	95	302	70
071800Z	22.4N 132.2E	120	22.3N 132.3E	120	8	0	25.3N 128.3E	110	113	10	27.8N 125.5E	100	283	25	--.- ---.-	--	--	--
080000Z	23.1N 131.1E	115	23.3N 130.9E	115	16	0	26.9N 126.3E	100	166	5	30.8N 125.5E	90	454	30	--.- ---.-	--	--	--
080600Z	23.6N 129.8E	110	23.9N 129.7E	110	19	0	27.7N 125.8E	100	205	10	31.9N 125.4E	90	523	45	--.- ---.-	--	--	--
081200Z	23.7N 128.2E	105	23.9N 128.3E	110	8	5	25.8N 123.2E	100	62	10	27.9N 119.7E	60	173	35	--.- ---.-	--	--	--
081800Z	23.9N 126.9E	100	23.9N 127.0E	105	5	5	25.2N 122.1E	90	45	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
090000Z	24.2N 125.6E	95	24.1N 125.4E	100	6	5	25.6N 120.8E	90	62	30	--.- ---.-	--	--	--	--.- ---.-	--	--	--
090600Z	24.5N 124.4E	90	24.3N 124.5E	95	13	5	25.9N 120.5E	85	101	40	--.- ---.-	--	--	--	--.- ---.-	--	--	--
091200Z	24.8N 122.9E	90	24.8N 123.0E	95	5	5	26.4N 118.4E	80	60	55	--.- ---.-	--	--	--	--.- ---.-	--	--	--
091800Z	24.8N 121.4E	75	25.2N 121.2E	90	26	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
100000Z	25.1N 119.8E	60	25.3N 119.8E	55	12	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
100600Z	25.4N 118.7E	45	25.4N 119.0E	50	16	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
101200Z	25.7N 117.6E	25	25.3N 117.4E	35	26	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	15NM	112NM	243NM	276NM	15NM	111NM	240NM	278NM
AVERAGE RIGHT ANGLE ERROR	10NM	67NM	129NM	119NM	10NM	67NM	130NM	126NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	14KTS	19KTS	20KTS	4KTS	15KTS	20KTS	23KTS
AVERAGE BIAS OF WIND ERROR	2KTS	2KTS	1KTS	-1KTS	2KTS	4KTS	2KTS	3KTS
NUMBER OF FORECASTS	27	26	22	18	31	27	23	19

TYPHOON FRAN

1200Z 03 SEP TO 1200Z 13 SEP

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
031200Z	9.1N 150.7E	25	9.5N 150.2E	25	38	0	10.0N 145.0E	40	144	0	11.0N 139.7E	60	295	10	12.5N 133.7E	80	473	5
031800Z	9.3N 150.1E	30	9.6N 149.0E	25	67	-5	10.1N 144.2E	40	142	0	11.0N 139.2E	60	313	5	12.6N 133.7E	80	460	-10
040000Z	9.5N 149.5E	30	9.3N 149.3E	30	17	0	9.7N 145.8E	45	139	0	10.5N 141.9E	65	323	5	11.6N 137.1E	80	503	-30
040600Z	9.9N 148.4E	35	9.7N 148.4E	35	12	0	10.7N 144.7E	50	132	5	12.7N 140.7E	70	263	5	14.1N 136.4E	85	408	-40
041200Z	10.5N 147.4E	40	10.2N 147.6E	35	21	-5	12.2N 144.3E	50	106	0	14.5N 141.1E	70	242	-5	16.4N 137.5E	85	370	-45
041800Z	11.1N 146.4E	40	10.9N 146.7E	40	21	0	12.7N 143.4E	65	129	10	15.0N 140.1E	75	273	-15	17.4N 136.9E	85	377	-45
050000Z	12.0N 145.4E	45	11.5N 145.4E	45	30	0	13.8N 140.8E	70	138	10	15.4N 137.1E	85	277	-25	16.7N 133.3E	100	374	-30
050600Z	12.9N 144.6E	45	12.7N 144.3E	50	21	5	15.7N 140.2E	75	88	10	18.3N 136.5E	90	172	-35	20.2N 133.0E	100	240	-30
051200Z	13.9N 143.8E	50	13.9N 144.3E	55	29	5	17.9N 141.9E	75	143	0	20.9N 139.1E	85	313	-45	24.1N 136.8E	90	365	-40
051800Z	14.8N 142.9E	55	14.8N 143.0E	55	6	0	18.3N 139.1E	75	78	-15	21.6N 135.5E	85	184	-45	24.3N 132.7E	90	183	-35
060000Z	15.9N 141.8E	60	15.7N 142.0E	65	17	5	19.4N 138.4E	85	113	-25	22.4N 135.5E	95	227	-35	25.3N 133.9E	95	267	-25
060600Z	17.1N 140.7E	65	16.7N 140.9E	65	26	0	20.6N 137.1E	85	118	-40	24.1N 134.2E	95	194	-35	27.1N 133.0E	90	226	-25
061200Z	18.2N 139.4E	75	17.9N 139.8E	70	29	-5	22.7N 135.1E	90	122	-40	26.7N 132.4E	100	181	-30	29.9N 132.2E	90	236	-20
061800Z	19.1N 138.0E	90	19.2N 138.2E	80	13	-10	24.0N 133.7E	100	150	-30	27.8N 132.0E	110	200	-15	31.7N 133.0E	100	306	-5
070000Z	20.0N 136.5E	110	20.2N 136.9E	85	21	-25	24.2N 131.6E	105	90	-25	27.7N 129.8E	110	110	-10	31.4N 130.7E	100	176	0
070600Z	20.8N 135.0E	125	20.7N 135.0E	125	6	0	23.6N 129.6E	150	60	20	27.0N 127.4E	130	78	15	31.0N 128.2E	110	119	15
071200Z	21.3N 133.5E	130	21.3N 133.6E	130	6	0	24.7N 128.6E	135	62	5	28.5N 127.2E	115	111	5	33.3N 131.0E	80	232	-10
071800Z	21.9N 132.2E	130	21.8N 132.1E	135	8	5	25.5N 127.7E	130	98	5	29.4N 127.4E	110	115	5	34.5N 132.9E	60	327	-25
080000Z	22.7N 131.4E	130	22.4N 131.4E	135	18	5	25.9N 128.6E	130	22	10	30.3N 130.2E	110	106	10	35.8N 135.8E	60	477	-25
080600Z	23.6N 130.7E	130	23.5N 130.7E	130	6	0	27.4N 128.8E	120	48	5	31.7N 130.5E	90	154	-5	36.4N 135.5E	50	504	-35
081200Z	24.5N 130.1E	130	24.4N 130.3E	125	12	-5	28.2N 128.9E	110	54	0	32.5N 131.0E	75	187	-15	37.2N 136.8E	45	588	-40
081800Z	25.3N 129.5E	125	25.3N 129.5E	120	0	-5	29.2N 128.0E	105	86	0	33.8N 129.9E	85	239	0	38.8N 135.8E	55	634	-25
090000Z	26.0N 129.0E	120	26.3N 128.9E	120	19	0	30.4N 127.4E	110	130	10	34.8N 130.1E	95	295	10	40.2N 137.1E	55	716	-20
090600Z	26.6N 128.8E	115	26.6N 128.8E	120	0	5	29.7N 128.9E	105	35	10	34.9N 131.7E	80	330	-5	39.6N 139.1E	45	717	-25
091200Z	27.3N 128.8E	110	27.3N 128.8E	115	0	5	30.6N 129.0E	100	67	10	35.5N 132.5E	75	383	-10	40.2N 139.1E	45	689	-20
091800Z	28.0N 128.9E	105	27.9N 128.9E	110	6	5	31.4N 129.0E	100	100	15	36.2N 133.0E	70	431	-10	40.6N 139.3E	40	622	-20
100000Z	28.8N 129.1E	100	28.7N 129.0E	105	8	5	32.6N 129.7E	95	162	10	37.1N 134.2E	65	487	-10	41.5N 141.5E	40	611	-5
100600Z	29.3N 129.4E	95	29.5N 129.3E	100	13	5	33.2N 130.9E	75	221	-10	37.5N 135.1E	60	497	-10	41.5N 142.5E	35	523	-5
101200Z	29.6N 129.6E	90	29.8N 129.7E	100	13	10	34.2N 131.9E	75	301	-10	38.6N 136.9E	60	550	-5	42.4N 145.1E	35	525	0
101800Z	29.8N 129.6E	85	29.9N 129.5E	95	8	10	33.2N 130.8E	75	221	-5	37.5N 135.5E	45	367	-15	--.- ---.-	--	--	--
110000Z	29.9N 129.4E	85	30.0N 129.4E	90	6	5	31.7N 129.5E	65	90	-10	35.9N 132.0E	45	59	0	--.- ---.-	--	--	--
110600Z	29.8N 129.2E	85	30.0N 129.4E	85	16	0	31.4N 129.4E	60	39	-10	35.7N 131.8E	45	91	5	--.- ---.-	--	--	--
111200Z	29.8N 129.0E	85	29.9N 129.2E	75	12	-10	30.8N 129.4E	50	60	-15	32.0N 130.0E	35	470	0	--.- ---.-	--	--	--
111800Z	30.0N 128.6E	80	29.9N 129.2E	70	32	-10	30.7N 129.3E	45	159	-15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
120000Z	30.4N 128.6E	75	30.2N 128.9E	65	20	-10	31.0N 128.9E	45	273	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
120600Z	31.0N 128.8E	70	30.9N 128.7E	65	8	-5	32.7N 128.9E	45	320	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
121200Z	31.8N 129.3E	65	31.8N 129.4E	65	5	0	33.9N 130.9E	45	348	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
121800Z	33.3N 130.0E	60	33.2N 130.3E	50	16	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
130000Z	35.1N 131.3E	45	34.8N 131.1E	45	20	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
130600Z	37.0N 132.8E	40	37.0N 132.6E	40	10	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
131200Z	39.0N 134.4E	35	38.6N 134.5E	35	24	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	14NM	130NM	258NM	422NM	16NM	130NM	258NM	422NM
AVERAGE RIGHT ANGLE ERROR	8NM	66NM	109NM	212NM	8NM	66NM	109NM	212NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	11KTS	14KTS	23KTS	4KTS	11KTS	14KTS	23KTS
AVERAGE BIAS OF WIND ERROR	-1KTS	-3KTS	-9KTS	-21KTS	-1KTS	-3KTS	-9KTS	-21KTS
NUMBER OF FORECASTS	38	37	33	29	41	37	33	29

TYPHOON HOPE

0600Z 14 SEP TO 1800Z 17 SEP

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
140600Z	19.4N 154.5E	40	18.5N 154.0E	45	61	5	19.8N 151.7E	65	239	5	21.8N 149.1E	75	419	15	--.- ---.-	--	--	--
141200Z	20.3N 154.5E	45	20.2N 154.6E	45	8	0	22.7N 154.4E	65	214	0	25.1N 152.2E	75	350	20	--.- ---.-	--	--	--
141800Z	21.3N 154.1E	50	20.9N 154.8E	55	46	5	23.5N 154.0E	75	261	5	25.7N 151.4E	80	375	30	--.- ---.-	--	--	--
150000Z	22.4N 153.5E	55	22.1N 153.4E	55	19	0	25.3N 151.5E	65	189	0	29.2N 150.2E	70	257	25	--.- ---.-	--	--	--
150600Z	23.7N 152.7E	60	23.2N 153.0E	60	34	0	27.8N 150.8E	70	126	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
151200Z	25.3N 151.7E	65	24.7N 152.2E	65	45	0	29.3N 150.2E	70	100	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--
151800Z	26.3N 150.3E	70	25.9N 151.8E	65	84	-5	30.3N 150.1E	70	109	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
160000Z	27.7N 149.2E	65	27.6N 149.0E	70	12	5	32.0N 146.8E	70	143	25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
160600Z	28.3N 148.7E	60	29.0N 148.0E	70	39	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
161200Z	29.9N 148.4E	55	29.8N 148.4E	70	6	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
161800Z	31.4N 148.4E	50	30.9N 148.1E	65	34	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
170000Z	33.4N 149.1E	45	33.2N 148.7E	50	23	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	34NM	173NM	350NM	0NM	34NM	173NM	350NM	0NM
AVERAGE RIGHT ANGLE ERROR	20NM	77NM	82NM	0NM	20NM	77NM	82NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	10KTS	23KTS	0KTS	5KTS	10KTS	23KTS	0KTS
AVERAGE BIAS OF WIND ERROR	5KTS	10KTS	23KTS	0KTS	5KTS	10KTS	23KTS	0KTS
NUMBER OF FORECASTS	12	8	4	0	12	8	4	0

TYPHOON IRIS

0600Z 14 SEP TO 0600Z 21 SEP

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
140600Z	15.9N 118.9E	30	16.0N 118.5E	30	24	0	15.7N 119.1E	35	54	0	16.5N 119.6E	35	128	-20	18.0N 119.9E	40	221	-25
141200Z	16.1N 119.2E	30	15.9N 119.1E	30	13	0	16.2N 119.7E	35	72	-5	17.3N 120.1E	35	151	-20	18.4N 120.5E	40	267	-25
141800Z	16.3N 119.5E	30	15.9N 119.3E	30	27	0	16.6N 119.9E	35	98	-10	17.7N 120.2E	35	186	-25	19.0N 120.7E	40	290	-30
150000Z	16.5N 119.4E	30	16.6N 119.7E	30	18	0	17.7N 120.2E	35	114	-15	18.8N 120.7E	35	227	-25	20.0N 122.0E	40	376	-30
150600Z	16.6N 119.0E	35	16.5N 119.2E	35	13	0	17.6N 119.8E	35	101	-20	18.7N 120.3E	40	234	-25	19.9N 121.5E	45	376	-30
151200Z	16.8N 118.6E	40	16.8N 119.3E	35	40	-5	17.6N 119.4E	40	108	-15	18.5N 119.5E	45	210	-20	19.4N 119.4E	50	293	-25
151800Z	17.2N 118.3E	45	17.0N 119.3E	35	58	-10	17.4N 119.3E	40	147	-20	18.2N 119.2E	45	220	-25	19.0N 119.0E	50	315	-25
160000Z	17.7N 118.2E	50	17.8N 118.1E	50	8	0	19.5N 116.3E	60	33	0	21.6N 115.4E	65	108	-5	23.9N 115.1E	40	212	-35
160600Z	18.1N 118.1E	55	18.2N 118.0E	55	8	0	20.0N 117.1E	65	70	0	22.0N 116.9E	65	163	-10	24.0N 117.0E	60	318	-15
161200Z	18.4N 117.7E	55	18.5N 118.0E	55	16	0	19.8N 117.4E	65	88	0	21.8N 116.8E	60	162	-15	23.7N 116.6E	60	316	-10
161800Z	18.7N 117.1E	60	18.8N 117.9E	60	40	0	20.0N 117.3E	65	98	-5	21.9N 116.8E	60	187	-15	23.9N 117.2E	50	370	-20
170000Z	19.1N 116.7E	60	18.5N 116.2E	60	46	0	18.5N 115.0E	70	377	0	18.2N 109.3E	60	263	-15	17.4N 105.1E	60	391	0
170600Z	19.2N 116.2E	65	19.6N 116.3E	65	25	0	21.2N 115.2E	70	69	-5	23.2N 115.0E	60	200	-15	24.6N 115.8E	45	362	0
171200Z	19.4N 115.9E	65	19.5N 115.9E	65	8	0	20.4N 114.1E	75	11	0	21.8N 113.4E	65	110	-5	--.- ---.-	--	--	--
171800Z	19.6N 115.6E	70	19.6N 115.5E	70	6	0	20.7N 114.0E	75	17	0	22.0N 113.6E	70	145	0	--.- ---.-	--	--	--
180000Z	19.8N 115.3E	70	19.8N 115.2E	70	6	0	20.5N 114.0E	70	68	-5	22.0N 113.7E	75	176	15	--.- ---.-	--	--	--
180600Z	20.1N 114.8E	75	20.0N 114.9E	70	8	-5	21.0N 114.1E	70	112	-5	22.5N 114.0E	70	221	25	--.- ---.-	--	--	--
181200Z	20.4N 114.3E	75	20.3N 114.3E	75	6	0	22.2N 113.0E	70	99	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
181800Z	20.7N 113.7E	75	20.6N 113.7E	75	6	0	21.8N 111.2E	65	30	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
190000Z	21.0N 112.9E	75	20.9N 113.0E	75	8	0	22.4N 110.7E	40	60	-20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
190600Z	21.2N 112.1E	75	21.3N 112.3E	75	13	0	22.7N 110.4E	35	78	-10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
191200Z	21.3N 111.5E	70	21.3N 111.6E	75	6	5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
191800Z	21.3N 111.1E	70	21.4N 111.1E	70	6	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
200000Z	21.4N 110.6E	60	21.4N 110.7E	55	6	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
200600Z	21.4N 110.2E	45	21.4N 110.2E	45	0	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	16NM	91NM	182NM	316NM	17NM	91NM	182NM	316NM
AVERAGE RIGHT ANGLE ERROR	10NM	58NM	105NM	202NM	11NM	58NM	105NM	202NM
AVERAGE MAGNITUDE OF WIND ERROR	1KTS	7KTS	16KTS	21KTS	1KTS	7KTS	16KTS	21KTS
AVERAGE BIAS OF WIND ERROR	-1KTS	-7KTS	-12KTS	-21KTS	-1KTS	-7KTS	-12KTS	-21KTS
NUMBER OF FORECASTS	21	21	17	13	25	21	17	13

TYPHOON JOAN

1200Z 19 SEP TO 0600Z 24 SEP

	BEST TRACK		WARNING		ERRORS		24 HOUR FORECAST		ERRORS		48 HOUR FORECAST		ERRORS		72 HOUR FORECAST		ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
191200Z	18.5N 152.3E	30	18.1N 152.[illegible]E	30	29	0	22.1N 152.2E	45	45	-5	26.3N 149.8E	55	136	-15	30.0N 146.9E	60	382	-5
191800Z	19.3N 152.3E	35	19.0N 152.5E	30	21	-5	23.0N 151.9E	45	28	-10	27.2N 149.2E	55	188	-15	30.8N 146.3E	60	439	-5
200000Z	20.4N 152.2E	40	20.0N 151.7E	35	37	-5	23.7N 150.5E	45	50	-15	27.7N 147.8E	55	263	-10	31.3N 145.6E	60	494	-5
200600Z	21.8N 152.0E	45	20.9N 151.5E	35	61	-10	24.5N 150.1E	50	77	-15	28.3N 147.0E	55	323	-10	31.8N 145.8E	60	505	-5
201200Z	22.7N 151.7E	50	23.1N 151.8E	40	25	-10	28.9N 151.1E	50	247	-20	34.2N 152.8E	55	425	-10	36.8N 158.5E	60	370	-5
201800Z	23.3N 151.5E	55	24.9N 151.7E	40	96	-15	30.5N 150.6E	50	319	-20	35.1N 153.3E	55	426	-10	37.0N 159.2E	50	293	-15
210000Z	23.8N 151.4E	60	23.9N 151.7E	55	17	-5	28.1N 152.2E	75	132	10	32.7N 156.3E	65	234	0	34.9N 163.8E	55	212	-5
210600Z	24.3N 151.5E	65	25.4N 151.3E	60	66	-5	30.0N 152.0E	75	218	10	33.8N 157.6E	65	258	0	35.5N 166.2E	55	204	-5
211200Z	24.8N 151.7E	70	25.1N 151.5E	65	21	-5	28.2N 151.8E	75	107	10	32.1N 154.6E	70	109	5	--.- ---.-	--	--	--
211800Z	25.3N 152.0E	70	25.8N 151.5E	70	40	0	28.8N 151.6E	80	140	15	32.5N 154.5E	75	152	10	--.- ---.-	--	--	--
220000Z	25.9N 152.3E	65	26.5N 151.9E	60	42	-5	30.0N 153.2E	45	102	-20	33.4N 157.0E	40	140	-20	--.- ---.-	--	--	--
220600Z	26.4N 152.7E	65	27.3N 152.1E	55	63	-10	30.7N 153.6E	45	104	-20	33.8N 157.8E	40	272	-20	--.- ---.-	--	--	--
221200Z	27.1N 153.4E	65	26.9N 153.1E	50	20	-15	29.3N 156.3E	40	96	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
221800Z	28.0N 154.1E	65	27.4N 153.9E	50	39	-15	30.1N 157.5E	40	131	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
230000Z	29.0N 154.8E	65	28.9N 154.9E	50	8	-15	31.5N 159.4E	40	179	-20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
230600Z	29.9N 155.4E	65	29.6N 156.0E	45	36	-20	32.2N 160.8E	35	272	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231200Z	30.9N 156.2E	65	30.5N 156.4E	45	26	-20	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
231800Z	32.3N 157.5E	65	31.2N 157.5E	40	66	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240000Z	34.5N 159.5E	60	33.7N 158.7E	35	62	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
240600Z	36.6N 162.2E	60	35.0N 160.0E	35	143	-25	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	47NM	140NM	244NM	363NM	46NM	140NM	244NM	363NM
AVERAGE RIGHT ANGLE ERROR	25NM	102NM	156NM	291NM	25NM	102NM	156NM	291NM
AVERAGE MAGNITUDE OF WIND ERROR	12KTS	17KTS	10KTS	6KTS	12KTS	17KTS	10KTS	6KTS
AVERAGE BIAS OF WIND ERROR	-12KTS	-11KTS	-8KTS	-6KTS	-12KTS	-11KTS	-8KTS	-6KTS
NUMBER OF FORECASTS	19	16	12	8	20	16	12	8

TYPHOON LOUISE

0000Z 30 OCT TO 1200Z 07 NOV

BEST TRACK			WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
	POSIT	WIND	POSIT	WIND	ERRORS DST	ERRORS WIND	POSIT	WIND	ERRORS DST	ERRORS WIND	POSIT	WIND	ERRORS DST	ERRORS WIND	POSIT	WIND	ERRORS DST	ERRORS WIND
300000Z	10.0N 148.8E	25	10.3N 148.8E	25	18	0	12.2N 146.2E	40	145	0	13.6N 143.3E	55	249	-5	15.1N 139.5E	70	323	-35
300600Z	9.8N 148.2E	30	9.5N 148.5E	25	25	-5	11.6N 146.0E	40	164	-5	13.1N 143.2E	50	292	-15	14.6N 139.4E	60	353	-60
301200Z	9.7N 147.3E	30	10.1N 147.5E	30	27	0	11.6N 144.7E	40	156	-10	13.0N 141.8E	50	280	-25	14.5N 137.8E	60	329	-75
301800Z	9.8N 146.1E	35	9.6N 145.9E	30	17	-5	10.5N 141.3E	40	45	-15	11.9N 136.8E	50	43	-40	14.2N 132.6E	60	104	-80
310000Z	10.2N 144.8E	40	9.9N 144.9E	40	19	0	10.8N 140.5E	50	47	-10	12.4N 136.3E	60	88	-45	14.2N 131.8E	70	139	-70
310600Z	10.6N 143.4E	45	10.7N 143.6E	45	13	0	12.2N 138.9E	55	62	-10	13.9N 135.1E	65	109	-55	15.9N 131.7E	75	202	-65
311200Z	11.0N 142.1E	50	10.7N 142.2E	50	19	0	11.9N 137.3E	65	30	-10	13.1N 133.4E	70	76	-65	14.8N 130.1E	75	179	-65
311800Z	11.2N 141.0E	55	11.2N 140.8E	55	12	0	12.0N 135.8E	70	25	-20	13.2N 131.8E	75	88	-65	14.6N 128.5E	80	160	-60
010000Z	11.2N 139.8E	60	11.5N 139.5E	60	25	0	12.7N 134.9E	80	30	-25	14.1N 131.1E	90	104	-50	15.3N 128.3E	100	151	-40
010600Z	11.2N 138.6E	65	11.3N 138.5E	65	8	0	12.1N 134.0E	85	48	-35	13.4N 129.8E	95	166	-45	14.9N 125.9E	110	198	-25
011200Z	11.4N 137.3E	75	11.5N 137.4E	65	8	-10	12.5N 133.2E	85	88	-50	14.0N 129.0E	95	165	-45	15.7N 125.2E	110	222	-20
011800Z	11.7N 136.1E	90	11.5N 136.2E	90	13	0	12.4N 131.7E	120	125	-20	13.7N 127.4E	125	187	-15	15.7N 123.9E	115	309	-10
020000Z	12.2N 134.8E	105	12.1N 134.8E	95	6	-10	13.6N 129.5E	125	78	-15	15.3N 125.5E	130	136	-10	18.2N 121.7E	120	352	0
020600Z	12.8N 133.6E	120	12.7N 133.6E	110	6	-10	14.7N 128.6E	130	64	-10	17.2N 124.7E	135	131	0	20.3N 121.8E	130	331	15
021200Z	13.6N 132.2E	135	13.7N 132.1E	115	8	-20	16.7N 126.5E	135	57	-5	20.4N 122.7E	130	256	0	24.7N 123.8E	120	274	10
021800Z	14.3N 130.8E	140	14.3N 131.1E	135	17	-5	17.2N 125.8E	150	67	10	21.1N 122.8E	145	258	20	25.3N 125.2E	130	238	25
030000Z	14.9N 129.5E	140	15.2N 129.3E	140	21	0	18.3N 124.3E	145	149	5	22.0N 123.2E	135	248	15	25.8N 127.7E	120	158	20
030600Z	15.7N 128.2E	140	15.7N 128.3E	135	6	-5	18.5N 124.8E	130	116	-5	21.7N 124.5E	125	173	10	25.2N 127.7E	110	220	15
031200Z	16.3N 127.4E	140	16.4N 127.2E	135	13	-5	19.4N 123.5E	130	199	0	22.8N 124.1E	125	227	15	25.7N 128.2E	110	291	20
031800Z	16.8N 126.9E	140	17.0N 126.6E	135	21	-5	19.8N 123.9E	125	185	0	22.4N 124.3E	115	272	10	25.8N 128.7E	100	391	15
040000Z	17.3N 126.7E	140	17.2N 126.5E	135	13	-5	18.9N 125.2E	125	160	5	20.5N 125.2E	115	373	15	23.7N 127.7E	100	635	30
040600Z	18.1N 126.8E	135	17.9N 126.8E	135	12	0	20.5N 127.1E	120	66	5	24.1N 130.3E	105	132	10	27.4N 135.9E	90	279	35
041200Z	19.0N 127.0E	130	19.2N 127.1E	135	13	5	22.5N 129.8E	120	88	10	25.7N 135.4E	100	151	10	28.6N 143.5E	80	151	35
041800Z	19.8N 127.2E	125	20.0N 127.3E	130	13	5	23.9N 129.0E	120	25	15	28.4N 133.2E	100	109	15	--.- ---.-	--	--	--
050000Z	20.6N 127.4E	120	20.7N 127.3E	125	8	5	23.4N 127.9E	105	149	5	27.3N 130.8E	85	377	15	--.- ---.-	--	--	--
050600Z	21.5N 127.6E	115	21.5N 127.5E	120	6	5	25.0N 128.8E	100	165	5	29.1N 133.1E	75	358	20	--.- ---.-	--	--	--
051200Z	22.5N 128.2E	110	22.4N 127.8E	120	23	10	26.0N 129.5E	100	219	10	30.0N 134.3E	75	431	30	--.- ---.-	--	--	--
051800Z	23.5N 129.1E	105	23.7N 129.1E	115	12	10	28.0N 132.6E	95	147	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--
060000Z	24.6N 130.3E	100	24.5N 130.5E	110	12	10	28.7N 138.7E	90	106	20	--.- ---.-	--	--	--	--.- ---.-	--	--	--
060600Z	25.9N 131.7E	95	25.9N 131.5E	110	11	15	30.7N 139.0E	90	42	35	--.- ---.-	--	--	--	--.- ---.-	--	--	--
061200Z	27.4N 133.3E	90	27.2N 133.2E	100	13	10	32.6N 142.0E	85	100	40	--.- ---.-	--	--	--	--.- ---.-	--	--	--
061800Z	28.9N 135.2E	85	28.7N 134.6E	85	34	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
070000Z	30.0N 137.3E	70	30.2N 137.0E	70	20	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
070600Z	30.6N 139.8E	55	30.9N 140.2E	65	27	10	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
071200Z	31.0N 142.6E	45	31.4N 143.3E	60	43	15	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	TYPHOONS WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	15NM	102NM	203NM	260NM	16NM	102NM	203NM	260NM
AVERAGE RIGHT ANGLE ERROR	11NM	69NM	112NM	139NM	12NM	69NM	112NM	139NM
AVERAGE MAGNITUDE OF WIND ERROR	6KTS	14KTS	25KTS	36KTS	5KTS	14KTS	25KTS	36KTS
AVERAGE BIAS OF WIND ERROR	1KTS	-2KTS	-11KTS	-17KTS	0KTS	-2KTS	-11KTS	-17KTS
NUMBER OF FORECASTS	32	31	27	23	35	31	27	23

5. INDIAN OCEAN AREA CYCLONE DATA

TROPICAL CYCLONE 20-76

2000Z 29 APR TO 2000Z 02 MAY

	BEST TRACK			WARNING					24 HOUR FORECAST					48 HOUR FORECAST					72 HOUR FORECAST				
							ERRORS					ERRORS					ERRORS					ERRORS	
	POSIT		WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND
291800Z	13.1N	94.2E	35	12.9N	93.9E	40	21	5	13.9N	92.6E	50	123	0	15.2N	91.7E	60	186	20	--.-	---.-	--	--	--
300000Z	13.4N	94.0E	40	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
300600Z	14.0N	93.6E	45	13.6N	93.2E	45	33	0	15.3N	92.2E	55	145	15	17.3N	92.2E	60	128	15	--.-	---.-	--	--	--
301200Z	14.8N	93.5E	45	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
301800Z	15.6N	93.8E	50	16.1N	94.2E	45	38	-5	17.8N	99.6E	20	315	-20	--.-	---.-	--	--	--	--.-	---.-	--	--	--
010000Z	16.0N	94.2E	50	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
010600Z	16.5N	94.4E	40	16.0N	94.0E	45	38	5	17.4N	98.0E	25	223	-20	--.-	---.-	--	--	--	--.-	---.-	--	--	--
011200Z	16.9N	94.3E	35	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
011800Z	17.3N	94.1E	40	16.8N	94.4E	50	34	10	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
020000Z	17.9N	94.1E	45	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
020600Z	18.3N	94.2E	45	18.0N	94.1E	50	19	5	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
021200Z	18.8N	94.4E	35	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	31NM	201NM	157NM	0NM
AVERAGE RIGHT ANGLE ERROR	12NM	162NM	107NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	14KTS	18KTS	0KTS
AVERAGE BIAS OF WIND ERROR	3KTS	-6KTS	18KTS	0KTS
NUMBER OF FORECASTS	6	4	2	0

TROPICAL CYCLONE 22-76

0800Z 02 JUN TO 0800Z 03 JUN

	BEST TRACK			WARNING					24 HOUR FORECAST					48 HOUR FORECAST					72 HOUR FORECAST				
							ERRORS					ERRORS					ERRORS					ERRORS	
	POSIT		WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND
020600Z	19.0N	70.8E	35	19.2N	70.8E	40	12	5	21.1N	71.3E	50	56	10	--.-	---.-	--	--	--	--.-	---.-	--	--	--
021200Z	19.4N	70.9E	40	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
021800Z	20.0N	71.3E	40	20.2N	71.0E	50	21	10	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
030000Z	20.6N	71.8E	40	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
030600Z	21.1N	72.3E	40	21.2N	73.2E	40	50	0	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
031200Z	21.7N	72.9E	35	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	28NM	56NM	0NM	0NM
AVERAGE RIGHT ANGLE ERROR	18NM	41NM	0NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	10KTS	0KTS	0KTS
AVERAGE BIAS OF WIND ERROR	5KTS	10KTS	0KTS	0KTS
NUMBER OF FORECASTS	3	1	0	0

TROPICAL CYCLONE 23-76

0800Z 10 SEP TO 2000Z 11 SEP

	BEST TRACK			WARNING					24 HOUR FORECAST					48 HOUR FORECAST					72 HOUR FORECAST				
							ERRORS					ERRORS					ERRORS					ERRORS	
	POSIT		WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND	POSIT		WIND	DST	WIND
100600Z	19.6N	91.2E	40	19.8N	91.1E	40	13	0	21.1N	89.8E	50	78	20	--.-	---.-	--	--	--	--.-	---.-	--	--	--
101200Z	20.2N	90.7E	40	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
101800Z	20.8N	90.1E	40	21.3N	89.3E	35	54	-5	22.5N	86.2E	25	65	5	--.-	---.-	--	--	--	--.-	---.-	--	--	--
110000Z	21.3N	89.5E	35	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
110600Z	21.9N	88.7E	30	21.3N	89.1E	35	42	5	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
111200Z	22.5N	87.8E	20	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
111800Z	23.3N	87.0E	20	22.8N	86.8E	30	32	10	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--

	ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	35NM	71NM	0NM	0NM
AVERAGE RIGHT ANGLE ERROR	13NM	34NM	0NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	5KTS	13KTS	0KTS	0KTS
AVERAGE BIAS OF WIND ERROR	3KTS	13KTS	0KTS	0KTS
NUMBER OF FORECASTS	4	2	0	0

TROPICAL CYCLONE 25-76

0800Z 15 OCT TO 2000Z 17 OCT

	BEST TRACK POSIT		BEST TRACK WIND	WARNING POSIT		WARNING WIND	WARNING ERRORS DST	WARNING ERRORS WIND	24 HOUR FORECAST POSIT		24 HOUR WIND	24 HOUR ERRORS DST	24 HOUR ERRORS WIND	48 HOUR FORECAST POSIT		48 HOUR WIND	48 HOUR ERRORS DST	48 HOUR ERRORS WIND	72 HOUR FORECAST POSIT		72 HOUR WIND	72 HOUR ERRORS DST	72 HOUR ERRORS WIND
150600Z	12.0N	59.6E	35	13.7N	58.3E	35	127	0	14.5N	55.3E	45	133	-5	17.2N	54.2E	45	295	5	--.-	---.-	--	--	--
151200Z	12.2N	58.9E	40	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
151800Z	12.3N	58.2E	45	11.9N	57.2E	40	63	-5	13.3N	54.0E	50	75	0	16.0N	53.8E	50	192	20	--.-	---.-	--	--	--
160000Z	12.5N	57.4E	50	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
160600Z	12.5N	56.3E	50	12.7N	56.3E	50	12	0	14.0N	53.8E	40	103	0	--.-	---.-	--	--	--	--.-	---.-	--	--	--
161200Z	12.4N	55.6E	50	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
161800Z	12.4N	54.9E	50	13.3N	55.2E	50	57	0	15.0N	52.9E	40	125	10	--.-	---.-	--	--	--	--.-	---.-	--	--	--
170000Z	12.1N	54.1E	45	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
170600Z	12.3N	53.5E	40	13.4N	53.2E	45	68	5	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
171200Z	12.6N	53.2E	35	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
171800Z	12.9N	52.9E	30	13.1N	52.5E	35	26	5	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--

ALL FORECASTS	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	59NM	109NM	244NM	0NM
AVERAGE RIGHT ANGLE ERROR	40NM	99NM	230NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	3KTS	4KTS	13KTS	0KTS
AVERAGE BIAS OF WIND ERROR	1KTS	1KTS	13KTS	0KTS
NUMBER OF FORECASTS	6	4	2	0

TROPICAL CYCLONE 30-76

0800Z 30 DEC TO 0800Z 02 JAN

	BEST TRACK POSIT		BEST TRACK WIND	WARNING POSIT		WARNING WIND	WARNING ERRORS DST	WARNING ERRORS WIND	24 HOUR FORECAST POSIT		24 HOUR WIND	24 HOUR ERRORS DST	24 HOUR ERRORS WIND	48 HOUR FORECAST POSIT		48 HOUR WIND	48 HOUR ERRORS DST	48 HOUR ERRORS WIND	72 HOUR FORECAST POSIT		72 HOUR WIND	72 HOUR ERRORS DST	72 HOUR ERRORS WIND
291800Z	8.1N	90.9E	30	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
300000Z	8.9N	91.2E	35	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
300600Z	9.5N	91.6E	40	10.2N	91.8E	35	43	-5	12.2N	92.7E	45	42	-10	14.0N	94.0E	40	40	5	--.-	---.-	--	--	--
301200Z	10.2N	92.1E	45	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
301800Z	10.8N	92.5E	50	11.5N	91.8E	35	59	-15	13.8N	92.2E	45	96	0	15.7N	93.8E	50	197	20	--.-	---.-	--	--	--
310000Z	11.3N	92.9E	55	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
310600Z	11.7N	93.2E	55	12.2N	93.6E	50	38	-5	14.8N	95.2E	55	99	20	17.7N	95.8E	40	390	20	--.-	---.-	--	--	--
311200Z	12.3N	93.3E	50	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
311800Z	12.7N	93.4E	45	14.0N	93.2E	50	79	5	16.8N	94.5E	40	257	10	--.-	---.-	--	--	--	--.-	---.-	--	--	--
010000Z	13.2N	93.7E	40	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
010600Z	13.4N	94.3E	35	13.7N	93.7E	40	39	5	16.0N	94.9E	35	276	15	--.-	---.-	--	--	--	--.-	---.-	--	--	--
011200Z	13.3N	94.8E	30	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
011800Z	12.5N	94.6E	30	15.0N	94.5E	40	149	10	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
020000Z	12.2N	93.9E	25	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
020600Z	11.8N	92.9E	20	12.3N	92.5E	20	38	0	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--
021200Z	12.0N	92.1E	20	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--	--.-	---.-	--	--	--

ALL FORECASTS	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	64NM	154NM	209NM	0NM
AVERAGE RIGHT ANGLE ERROR	43NM	114NM	147NM	0NM
AVERAGE MAGNITUDE OF WIND ERROR	6KTS	11KTS	15KTS	0KTS
AVERAGE BIAS OF WIND ERROR	-1KTS	7KTS	15KTS	0KTS
NUMBER OF FORECASTS	7	5	3	0

6. CENTRAL NORTH PACIFIC HURRICANE DATA

HURRICANE KATE

1200Z 20 SEP TO 1200Z 02 OCT

	BEST TRACK		WARNING				24 HOUR FORECAST				48 HOUR FORECAST				72 HOUR FORECAST			
					ERRORS				ERRORS				ERRORS				ERRORS	
	POSIT	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND	POSIT	WIND	DST	WIND
211800Z	12.9N 140.5E	30	12.7N 140.7E	30	17	0	13.9N 144.5E	35	145	5	14.8N 148.3E	35	377	-10	15.0N 152.2E	30	575	-35
220000Z	13.4N 141.2E	30	13.3N 141.0E	30	13	0	14.8N 145.0E	35	184	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
220600Z	13.6N 141.6E	30	13.8N 141.9E	30	21	0	15.0N 145.8E	35	237	0	15.0N 150.1E	35	469	-25	15.0N 154.3E	35	661	-35
221200Z	13.9N 142.0E	30	14.2N 142.8E	30	50	0	15.0N 146.8E	35	293	-5	15.0N 151.2E	35	522	-25	15.0N 155.3E	35	701	-35
221800Z	14.0N 142.0E	30	14.3N 141.9E	35	19	5	15.0N 143.5E	35	107	-10	15.9N 146.7E	40	276	-25	16.4N 149.8E	40	381	-30
230000Z	14.1N 141.9E	35	14.0N 141.8E	35	8	0	14.0N 142.5E	35	42	-10	14.7N 146.7E	40	240	-30	15.5N 151.0E	40	410	-30
230600Z	14.1N 141.8E	35	14.0N 141.8E	35	6	0	14.0N 142.5E	35	38	-25	14.7N 146.7E	40	223	-30	15.5N 151.0E	40	390	-30
231200Z	14.2N 141.8E	40	14.2N 141.7E	40	6	0	14.2N 142.5E	40	18	-20	14.7N 146.7E	45	205	-25	15.5N 151.0E	45	369	-25
231800Z	14.3N 141.8E	45	14.2N 141.8E	40	6	-5	14.6N 142.7E	50	38	-15	15.8N 144.6E	55	112	-15	16.5N 146.5E	55	104	-25
240000Z	14.4N 141.9E	45	14.6N 142.2E	40	21	-5	15.0N 143.3E	50	67	-20	15.8N 144.6E	55	96	-15	16.5N 146.5E	55	91	-30
240600Z	14.4N 142.0E	60	14.3N 142.5E	60	30	0	15.0N 143.8E	65	75	-5	15.7N 145.0E	70	77	0	16.2N 146.3E	65	70	-20
241200Z	14.3N 142.2E	60	14.3N 142.2E	60	0	0	14.5N 143.0E	70	21	0	15.0N 145.0E	65	24	-5	15.0N 148.0E	65	191	-15
241800Z	14.1N 142.3E	65	14.1N 142.3E	65	0	0	14.5N 143.5E	70	19	0	15.0N 145.5E	65	54	-15	15.0N 148.5E	65	215	-15
250000Z	14.1N 142.6E	70	14.1N 142.8E	70	12	0	14.1N 145.0E	70	59	0	14.1N 147.0E	70	162	-15	14.1N 149.0E	70	281	-5
250600Z	14.1N 142.9E	70	14.1N 143.0E	70	6	0	14.1N 144.0E	70	35	0	14.1N 145.0E	65	137	-20	14.1N 146.0E	60	285	-15
251200Z	14.2N 143.2E	70	14.2N 143.4E	70	12	0	14.2N 144.5E	70	54	0	14.2N 145.5E	65	167	-15	14.2N 147.5E	60	296	-15
251800Z	14.2N 143.6E	70	14.1N 143.6E	75	6	5	14.1N 144.8E	75	96	-5	14.1N 146.0E	70	203	-10	14.1N 147.2E	65	335	-5
260000Z	14.3N 144.0E	70	14.3N 144.0E	70	0	0	14.5N 145.2E	70	90	-15	14.6N 146.4E	70	215	-5	14.7N 147.6E	60	356	-5
260600Z	14.6N 144.3E	70	14.6N 144.3E	70	0	0	15.2N 145.7E	65	60	-20	15.7N 147.0E	60	180	-15	16.2N 148.3E	55	328	-10
261200Z	15.1N 144.6E	70	15.3N 144.5E	70	13	0	16.8N 146.5E	70	64	-10	17.2N 148.9E	65	118	-10	16.9N 151.3E	60	293	0
261800Z	15.7N 144.9E	80	15.7N 144.9E	90	0	10	16.9N 146.5E	75	54	-5	17.0N 149.1E	65	143	-5	17.0N 152.2E	60	323	5
270000Z	16.0N 145.0E	85	15.9N 145.1E	85	8	0	17.3N 146.0E	75	64	0	17.9N 148.0E	65	178	0	18.0N 151.0E	65	299	15
270600Z	16.4N 145.1E	85	16.5N 145.0E	85	8	0	18.3N 145.0E	75	132	0	20.5N 143.5E	65	415	0	22.4N 140.5E	60	659	10
271200Z	17.0N 145.4E	80	17.0N 145.4E	85	0	5	18.5N 146.9E	75	87	0	19.9N 148.6E	60	198	0	21.0N 150.5E	50	237	5
271800Z	17.5N 145.8E	80	17.2N 145.5E	80	25	0	18.6N 146.9E	75	133	5	19.9N 148.6E	60	250	5	21.0N 150.5E	50	251	5
280000Z	18.2N 146.6E	75	18.2N 146.6E	75	0	0	20.6N 149.7E	65	29	0	22.5N 153.5E	55	58	5	25.0N 157.0E	45	260	5
280600Z	18.7N 147.3E	75	18.7N 147.1E	75	11	0	20.9N 149.2E	65	96	0	22.3N 152.0E	55	79	5	24.5N 155.0E	45	161	10
281200Z	19.1N 148.3E	75	19.1N 148.3E	75	0	0	20.6N 152.3E	65	84	5	22.0N 156.3E	55	269	10	23.3N 160.3E	45	461	10
281800Z	19.4N 149.1E	70	19.4N 149.0E	70	6	0	20.7N 152.6E	60	104	5	22.3N 156.5E	50	282	5	24.8N 159.5E	40	399	10
290000Z	20.2N 150.0E	65	20.2N 150.0E	65	0	0	22.2N 153.6E	55	70	5	24.2N 157.2E	50	278	10	26.5N 161.0E	40	446	10
290600Z	21.1N 150.9E	65	21.2N 150.8E	65	8	0	23.9N 153.9E	55	75	5	26.0N 157.5E	50	287	15	--.- ---.-	--	--	--
291200Z	21.8N 151.5E	60	21.7N 151.6E	65	8	5	23.8N 155.1E	45	160	0	27.4N 157.7E	35	313	0	--.- ---.-	--	--	--
291800Z	22.4N 152.2E	55	22.4N 152.2E	55	0	0	25.3N 155.2E	35	164	-10	27.8N 157.3E	30	287	0	--.- ---.-	--	--	--
300000Z	22.8N 152.5E	50	22.8N 152.5E	50	0	0	25.6N 155.7E	35	190	-5	28.5N 158.8E	30	357	0	--.- ---.-	--	--	--
300600Z	23.5N 152.6E	50	23.5N 152.6E	50	0	0	25.5N 154.5E	35	124	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
301200Z	24.6N 152.3E	45	24.6N 152.3E	50	0	5	29.2N 150.5E	30	233	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--
301800Z	24.9N 152.2E	45	25.0N 152.1E	45	8	0	28.8N 150.6E	30	203	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010000Z	25.2N 152.2E	40	25.5N 152.2E	40	18	0	28.0N 151.5E	30	135	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--
010600Z	25.4N 152.2E	35	25.8N 152.0E	35	26	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
011200Z	25.6N 152.2E	35	25.7N 152.3E	35	8	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
011800Z	25.8N 152.4E	30	25.9N 152.4E	30	6	0	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--
020000Z	26.0N 152.7E	30	25.9N 152.7E	25	12	-5	--.- ---.-	--	--	--	--.- ---.-	--	--	--	--.- ---.-	--	--	--

	HURRICANES WHILE WIND OVER 35KTS				ALL FORECASTS			
	WARNING	24-HR	48-HR	72-HR	WARNING	24-HR	48-HR	72-HR
AVERAGE FORECAST ERROR	7NM	98NM	213NM	333NM	9NM	103NM	220NM	339NM
AVERAGE RIGHT ANGLE ERROR	3NM	73NM	134NM	216NM	5NM	80NM	144NM	230NM
AVERAGE MAGNITUDE OF WIND ERROR	1KTS	6KTS	12KTS	16KTS	1KTS	6KTS	11KTS	16KTS
AVERAGE BIAS OF WIND ERROR	1KTS	-5KTS	-8KTS	-12KTS	0KTS	-4KTS	-8KTS	-10KTS
NUMBER OF FORECASTS	35	35	31	27	42	38	33	29

APPENDIX

ABBREVIATIONS, ACRONYMS AND DEFINITIONS

Abbreviations, acronyms and definitions which apply for the purpose of this report.

1. ABBREVIATIONS AND ACRONYMS

AC&W	Aircraft Control and Warning
AIREP	Aircraft Weather Reports (Commercial and Military)
AJTWC	Alternate Joint Typhoon Warning Center
AUTODIN	Automatic Digital Network
AUTOVON	Automatic Voice Network
AWN	Automated Weather Network
AWS	Air Weather Service
CINCPAC	Commander in Chief Pacific
CINCPACFLT	Commander in Chief U. S. Pacific Fleet
CDRUSACSG	Commander, U. S. Army CINCPAC Support Group
DMSP	Defense Meteorological Satellite Program
FLEWEACEN/JTWC	Fleet Weather Central/ Joint Typhoon Warning Center
NEDN	Naval Environmental Data Network
NESS	National Environmental Satellite Service
NOAA	National Oceanic and Atmospheric Administration
NTCC	Naval Telecommunications Center
NWS	National Weather Service
PACOM	Pacific Command
SLP (MSLP)	Sea Level Pressure (Minimum Sea Level Pressure)
SMS	Synchronous Meteorological Satellite
TCARC	Tropical Cyclone Aircraft Reconnaissance Coordinator
TC	Tropical Cyclone
TD	Tropical Depression
WMO	World Meteorological Organization

2. DEFINITIONS

ALTERNATE JOINT TYPHOON WARNING CENTER-The AJTWC is Detachment 17, 30th Weather Squadron, Yokota AB, Japan with assistance from the Naval Weather Service Facility, Yokosuka, Japan.

CYCLONE-A closed atmospheric circulation rotating about an area of low pressure (counterclockwise in the northern hemisphere).

EXTRATROPICAL-A term used in warnings and tropical summaries to indicate that a cyclone has lost its "tropical characteristics". The term implies both poleward displacement from the tropics and the conversion of the cyclone's primary energy sources from release of latent heat of condensation to baroclinic processes. The term carries no implications as to strength or size.

EYE/CENTER-Refers to the roughly circular central area of a well developed tropical cyclone usually characterized by comparatively light winds and fair weather. If more than half surrounded by wall cloud, the word "eye" is used, otherwise the area is referred to as a center.

MAXIMUM SUSTAINED WIND-Maximum surface wind speed of a cyclone averaged over a 1-minute period of time. Wind speed is subject to gusts which bring a sudden temporary increase in speed (i.e., on the order of a few seconds). Peak gusts over water average 20 to 25 percent higher than the sustained 1-minute wind speed.

SIGNIFICANT TROPICAL CYCLONE-A tropical cyclone becomes "significant" with the issuance of the first numbered warning by the responsible warning agency.

TROPICAL CYCLONE-A nonfrontal low pressure system of synoptic scale developing over tropical or subtropical waters and having a definite organized circulation.

TROPICAL CYCLONE AIRCRAFT RECONNAISSANCE COORDINATOR-A CINCPACAF representative designated to levy tropical cyclone aircraft weather reconnaissance requirements on reconnaissance units within a designated area of the PACOM and to function as coordinator between CINCPACAF, aircraft weather reconnaissance units, and the appropriate typhoon/hurricane warning center.

TROPICAL DEPRESSION-A tropical cyclone in which the maximum sustained surface wind (1-minute mean) is 33 kt or less.

TROPICAL DISTURBANCE-A discrete system of apparently organized convection--generally 100 to 300 miles in diameter--originating in the tropics or subtropics, having a nonfrontal migratory character,

and having maintained its identity for 24 hours or more. It may or may not be associated with a detectable perturbation of the wind field. As such, it is the basic generic designation which, in successive stages of intensification, may be classified as a tropical depression, tropical storm or typhoon.

TROPICAL STORM-A tropical cyclone with maximum sustained surface winds (1-minute mean) in the range of 34 to 63 kt, inclusive.

TYPHOON/HURRICANE-A tropical cyclone in which the maximum sustained surface wind (1-minute mean) is 64 kt or greater.

SUPER TYPHOON/HURRICANE-A typhoon/hurricane in which the maximum sustained surface wind (1-minute mean) is 130 kt or greater.

WALL CLOUD-An organized band of cumuliform clouds immediately surrounding the central area of a tropical cyclone. Wall clouds may entirely enclose the eye or only partially surround the center.

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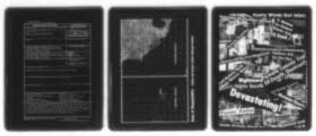

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Typhoons	Tropical storms
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Annual publication summarizing the tropical cyclone season in the western North Pacific, the North Indian Ocean, and the central North Pacific. A brief narrative is given on each typhoon in the western North Pacific including the best track. Forecast verification data and statistics for JTWC are summarized. Research efforts at JTWC are discussed briefly.

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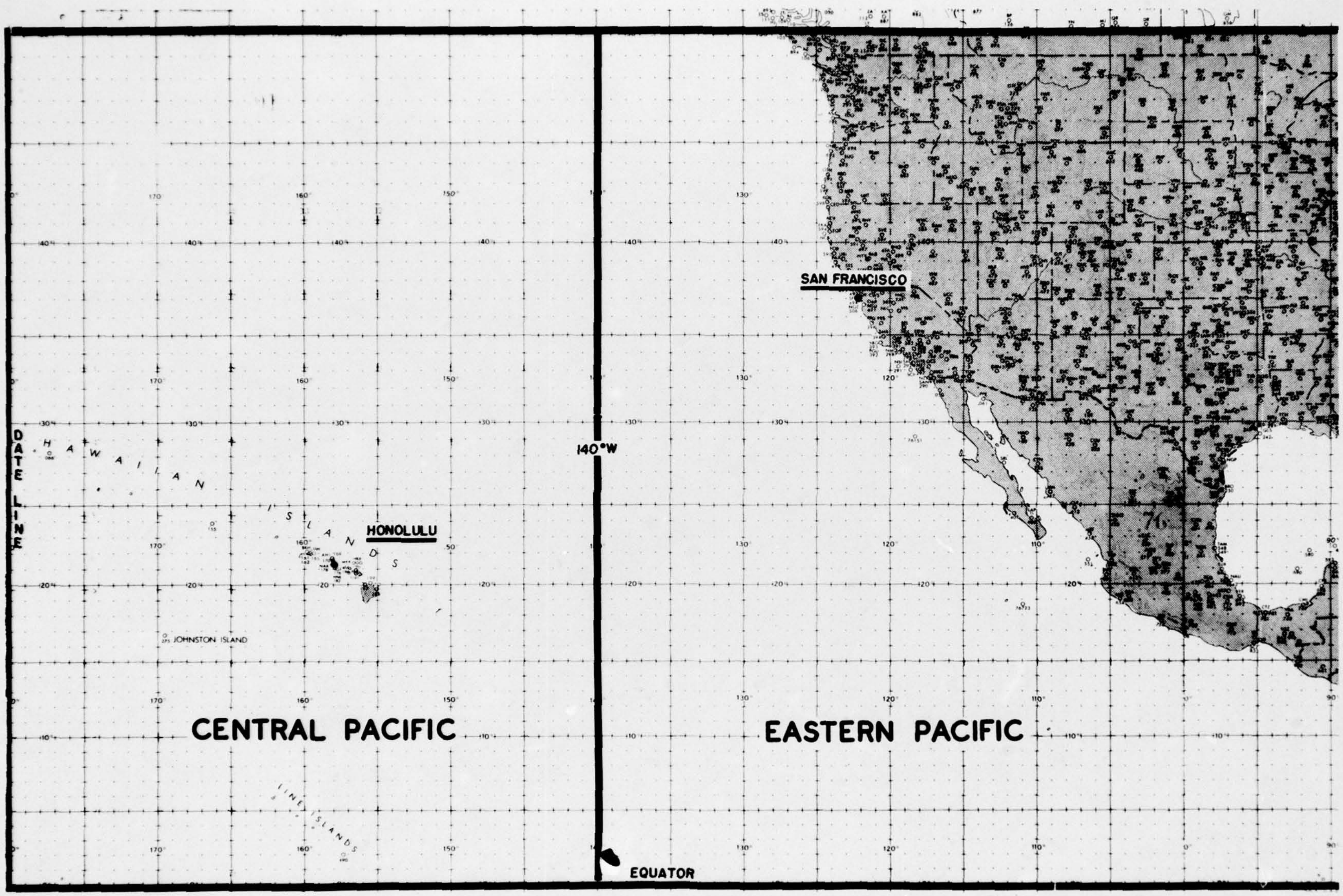

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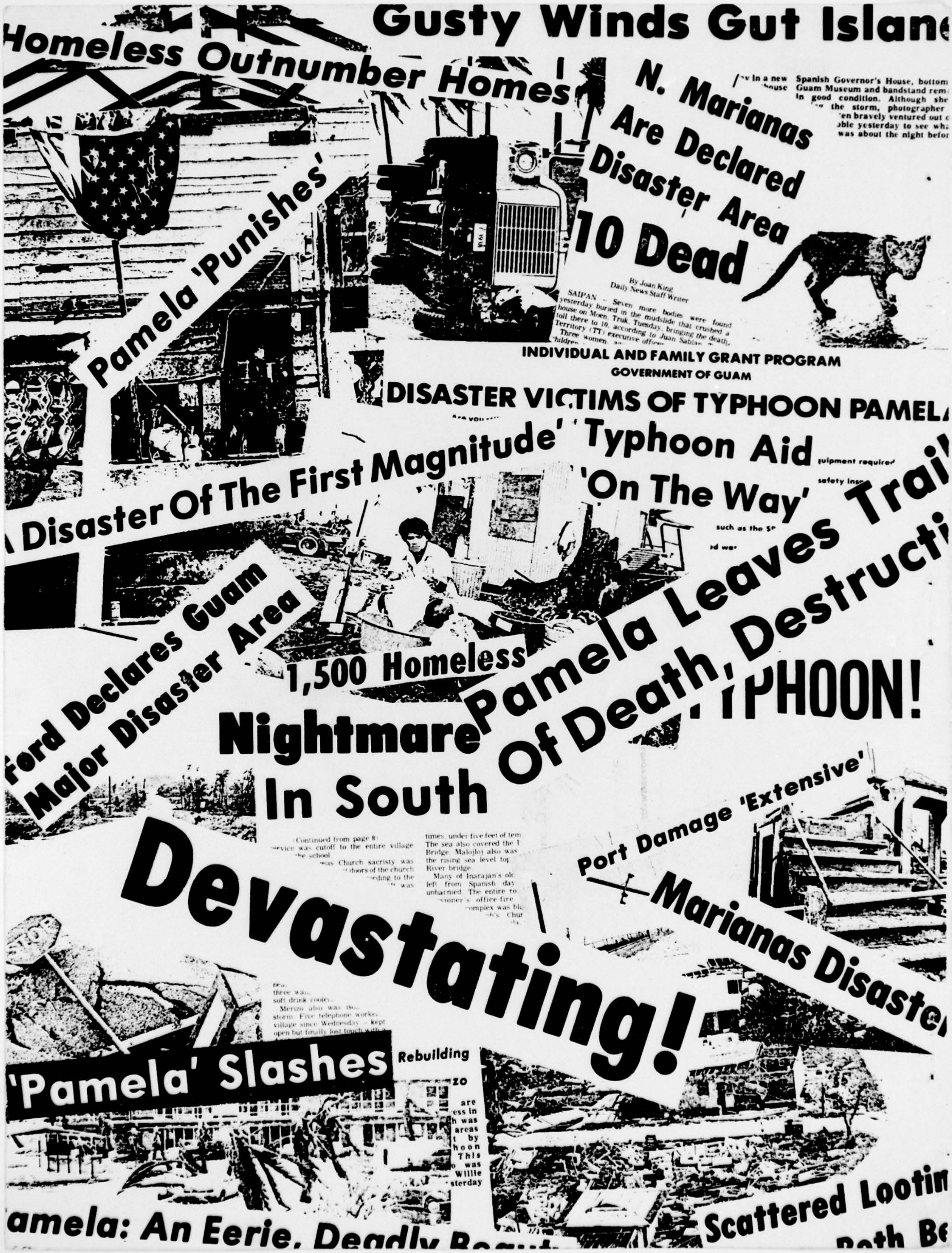

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